

# NAVAL POSTGRADUATE SCHOOL MONTEREY, CALIFORNIA



## THESIS

THE AIR TRANSPORTATION OF HAZARDOUS  
MATERIALS: A COMPARATIVE STUDY  
BETWEEN THE MILITARY  
AND CIVILIAN SECTORS

by

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March, 1995

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19950906 036

DTIC QUALITY INSPECTED 5

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE March 1995		3. REPORT TYPE AND DATES COVERED Master's Thesis
4. TITLE AND SUBTITLE THE AIR TRANSPORTATION OF HAZARDOUS MATERIALS: A COMPARATIVE STUDY BETWEEN THE MILITARY AND CIVILIAN SECTORS			5. FUNDING NUMBERS	
6. AUTHOR(S) Brooks, Paul A.				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey CA 93943-5000			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (maximum 200 words) This thesis compares the hazardous material air transportation policies and procedures of the Department of Defense with those of the civilian sector. Starting with definitions and terminology, it examines all classes of hazardous material. The thesis contains an in depth discussion of proper packaging, marking, labeling, handling and documentation procedures. A synopsis of current regulations pertaining to hazardous material air transportation, including Title 49 of the Code of Federal Regulations, the International Air Transport Association Dangerous Goods Regulation, and the recently released Air Force Joint Manual 24-204, provides a basis for comparison. The thesis describes legislative changes resulting from United Nations recommendations and the passage of the 1990 Hazardous Materials Uniform Transportation Safety Act. Differences in training, as well as transportation and handling procedures, between the military and civilian sectors are analyzed to determine if adoption of civilian practices could benefit the Department of Defense.				
14. SUBJECT TERMS HAZARDOUS MATERIAL: MILITARY AIR TRANSPORTATION: AIR TRANSPORTATION: AIR FORCE JOINT MANUAL 24-204			15. NUMBER OF PAGES 135	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)  
Prescribed by ANSI Std. Z39-18 298-102



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A COMPARATIVE STUDY BETWEEN THE MILITARY AND CIVILIAN  
SECTORS

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Submitted in partial fulfillment  
of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

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Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
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Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	





## **ABSTRACT**

This thesis compares the hazardous material air transportation policies and procedures of the Department of Defense with those of the civilian sector. Starting with definitions and terminology, it examines all classes of hazardous material. The thesis contains an in depth discussion of proper packaging, marking, labeling, handling and documentation procedures. A synopsis of current regulations pertaining to hazardous material air transportation, including Title 49 of the Code of Federal Regulations, the International Air Transport Association Dangerous Goods Regulation, and the recently released Air Force Joint Manual 24-204, provides a basis for comparison. The thesis describes legislative changes resulting from United Nations recommendations and the passage of the 1990 Hazardous Materials Uniform Transportation Safety Act. Differences in training, as well as transportation and handling procedures, between the military and civilian sectors are analyzed to determine if adoption of civilian practices could benefit the Department of Defense.



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## I. INTRODUCTION

### A. BACKGROUND

As technological advances in telecommunications, computers and transportation continue to shrink the world to the point where it is now described in some circles as a "global village", new paradigms drive our actions in many areas. The transportation field is one such area. Air transportation in particular continues to evolve as it prepares to meet the challenges and opportunities of the 21st century. The dramatic rise in the use of overnight package delivery services, airline deregulation and joint ventures between United States and foreign air carriers attest to a smaller, more competitive world. This shift to a global paradigm is especially true in the area of hazardous materials transportation.

Until January 1, 1991, shippers of hazardous material, both commercial and Department of Defense, had to worry about complying with different international, domestic and military hazardous material regulations. Today, all shipments and packaging must adhere to the new United Nations recommendations which standardized worldwide shipping and handling procedures. Hazardous materials, referred to as dangerous goods in the air transportation sector, are substances capable of posing a significant risk to health, property or public safety. Hazardous materials include the following commodity classes: explosives, flammable gases, non-flammable gases, non-toxic gases, toxic gases, flammable liquids, flammable solids, substances liable to spontaneous combustion, substances which on contact with water emit flammable gases, oxidizers, organic peroxides, poisonous substances, infectious substances, radioactive materials, corrosives and others not specifically categorized.

The safe transport of hazardous materials encompasses the

proper packaging, marking, labeling and handling as well as correct preparation of shipping documents. Recent changes place greater emphasis on emergency response procedures.

Current regulations pertaining to hazardous materials transportation are promulgated by Title 49 of the Code of Federal Regulations for shipments traveling within the United States, the IATA Dangerous Goods Regulations published by the International Air Transport Association for international movement, and the joint publication NAVSUP 505 / AFR 71-4 for cargo carried on Department of Defense owned or controlled aircraft. A new military regulation has just been completed. Distribution has begun for Joint Manual 24-204 which replaces the NAVSUP 505 / AFR 71-4 and conforms more closely with the new United Nations recommendations.

#### **B. OBJECTIVE OF THE RESEARCH**

The objective of this research effort is to compare and contrast civilian and military hazardous materials air transportation procedures. Where differences are found, an analysis will be conducted to determine if adoption of civilian practices could benefit the Department of Defense. In order to assess the similarities and differences, military and civilian regulations and training programs are examined and compared. A determination of possible advantages of one over the other will be made where applicable. It is recognized that the military has a unique mission and that wartime requirements frequently necessitate procedures which contrast sharply with the civilian sector.

#### **C. THE RESEARCH QUESTION**

The central objective of this research is to explore ways in which the Department of Defense can improve the air transport of hazardous materials. To this end, the following question was posed: What are the similarities and differences

between the hazardous material air transportation procedures used by the Department of Defense and the civilian sector? Subsidiary questions which are relevant to this research are:

1. In what ways can the Department of Defense benefit by modifying its procedures to more closely match those of the civilian sector?
2. Are there drawbacks to more closely aligning procedures with the civilian sector?
3. In what ways can Department of Defense hazardous material training programs be improved?

#### **D. SCOPE AND LIMITATIONS OF THE RESEARCH**

The scope of this thesis provides a current analysis of all aspects of hazardous materials air transportation procedures in the civilian and military sectors. It compares and contrasts the areas of packaging, marking, labeling, placarding, allowable shipping quantities per aircraft, stowage locations and required documentation between the two operations. The thesis also encompasses the issue of mobilization and altered procedures in time of war. Readiness and the capability to expeditiously deploy troops and equipment must be considered in the procedural analysis.

The scope of this thesis is limited in that there is no attempt to analyze the costs associated with such factors as packaging and training. Cost data for cargo handling is rarely broken down into hazard classes. Additionally, hazardous material volume figures, both tonnage and number of shipments, are also not segregated from general freight totals, thus tonnage quantities were not available for analysis.

Also limiting the scope of this research is the emergence of a new Department of Defense regulation, Air Force Joint Manual 24-204, which may bridge many of the currently existing differences between military and civilian procedures.

## E. RESEARCH METHODOLOGY

The methodology used for this thesis includes an examination of the two major providers of hazardous material air transportation services, Department of Defense owned or controlled aircraft and commercial air carriers, and the regulations and procedures governing their actions. Consequently, the following descriptions and synopses were developed to facilitate the analysis:

1. A description of the Hazardous Material Classes and the procedures necessary to prepare the required packaging and documentation
2. A synopsis of Title 49 of the Code of Federal Regulations
3. A synopsis of the International Air Transport Association (IATA) Dangerous Goods Regulation
4. A description of commercial carrier training and operations
5. A synopsis of the Department of Defense Joint Publication AFR 71-4/NAVSUP PUB 505.
6. A synopsis of the new Air Force Joint Manual 24-204
7. A description of Department of Defense training and operations
8. A comparison of Air Force, Navy and commercial procedures.

Phone interviews were conducted with key people involved in hazardous material training and handling in both the military and civilian sectors. The author of the new Air Force Joint Manual 24-204, Duane Pfund, was interviewed. In addition, the key players for the other service components who provided input were questioned. Assistance in analyzing issues of mobilization was obtained from officials at the Air Mobility Command and the United States Transportation Command (USTRANSCOM).

## F. ORGANIZATION OF THE STUDY

Chapter II provides a description of the various classes of hazardous materials. Extracted from the IATA Dangerous Goods Regulation and the 49 CFR, each hazard class and subdivision is defined and described. Additionally, the procedures involved in the preparation of hazardous materials for shipment are discussed briefly.

Chapter III takes a walk through Title 49 of the Code of Federal Regulations which governs hazardous materials movement in the United States via ocean, surface (rail/highway) as well as air. Rules pertaining to the determination of a proper shipping name, marking, labeling, packaging, placarding, quantity restrictions, shipping paper preparation and emergency response are examined.

Chapter IV looks at the International Air Transport Association (IATA) Dangerous Goods Regulations. The eleven sections dealing with the various aspects of the shipping and handling of dangerous goods are discussed sequentially.

Chapter V discusses commercial carrier dangerous goods operations in general. Acceptance and handling procedures, employee training and the emergency response procedures used to reduce or eliminate hazards resulting from damage, spillage, and fire are examined.

Chapter VI addresses the Department of Defense joint publication AFR 71-4 / NAVSUP PUB 505. This is the military's hazardous material air transportation bible. A synopsis of the various chapters is provided. Preparation of the DOD unique certification form 1387-2 is also covered.

Chapter VII looks at the new Air Force Joint Manual 24-204 recently completed by the Air Force Material Command. Nearly seven years in the making, this publication assimilates input from many sources including the Navy Supply Systems Command and replaces the AFR 71-4 / NAVSUP PUB 505. It

incorporates the recent changes recommended by the United Nations and previously included in the IATA Dangerous Goods Regulation.

Chapter VIII focuses on Department of Defense operations. Peacetime, mobility and tactical exercise scenarios are discussed and contrasted.

Chapter IX compares the Department of Defense hazardous material air transportation procedures with those of the civilian sector. Differences in regulations, training, commodities handled, and packaging requirements are explored.

Chapter X provides conclusions and offers recommendations for improved operations and training.

## II. HAZARDOUS MATERIAL CLASSIFICATIONS

### A. INTRODUCTION

As discussed in Chapter I, hazardous materials are articles or substances which are capable of posing a significant risk to health, safety or to property when transported in commerce. [Refs 1, 2, 3]

Hazardous materials are classified according to their chemical and/or physical properties or their relative hazard to health. The classes are further broken down into divisions which describe their characteristics in greater detail. Table 1 shows the class breakdown.

<u>CLASS</u>	<u>DESCRIPTION</u>	<u>DIVISIONS</u>
1	Explosives	1.1, 1.2, 1.3, 1.4, 1.5, 1.6
2	Flammable Gases	2.1
2	Non-Flammable, Non-Toxic Gases	2.2
2	Toxic Gases	2.3
3	Flammable Liquids	N/A
4	Flammable Solids	4.1
4	Substances Liable to Spontaneous Combustion	4.2
4	Substances Which On Contact With Water Emit Flam Gas	4.3
5	Oxidizers	5.1
5	Organic Peroxides	5.2
6	Poisonous Substances	6.1
6	Infectious Substances	6.2
7	Radioactive Materials	N/A
8	Corrosives	N/A
9	Miscellaneous	N/A

Table 1. Hazard Classes, Descriptions and Divisions



## 1. Class 1 - Explosives

An explosive is any substance or article, including a device, which is designed to function by explosion (i.e., an extremely rapid release of gas and heat) or which, by chemical reaction within itself, is able to function in a similar manner even if not designed to function by explosion. [Ref 2]

Explosives in class 1 are divided into six divisions as follows:

(1) *Division 1.1* consists of explosives that have a mass explosion hazard. A mass explosion is one which affects almost the entire load instantaneously.

(2) *Division 1.2* consists of explosives that have a projection hazard but not a mass explosion hazard.

(3) *Division 1.3* consists of explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.

(4) *Division 1.4* consists of explosives that present a minor explosion hazard. The explosive effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package.

(5) *Division 1.5* consists of very insensitive explosives. This division is comprised of substances which have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.

(6) *Division 1.6* consists of extremely insensitive articles which do not have a mass explosion hazard. This division is comprised of articles which contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation. [Refs 1, 2]

## 2. Class 2 - Gases: Flammable and Non-flammable, Toxic and Non-toxic

Gases in this class possess a wide range of properties and characteristics. For this reason, gases are divided into three divisions and four subdivisions as follows:

(1) *Division 2.1 (Flammable gas)* Any material which is a gas at 20 degrees C (68 degrees F) or less and 101.3 kPa (14.7 psi) of pressure and is ignitable when in a mixture of 13 percent or less by volume with air or has a flammable range with air of at least 12 percent. [Ref 1]

(2) *Division 2.2 (Non-flammable, non-poisonous compressed gas-including compressed gas, liquefied gas, pressurized cryogenic gas and compressed gas in solution).* Any material or mixture which exerts in the packaging an absolute pressure of 280 kPa (41 psia) or greater at 20 degrees C (68 degrees F) and does not meet the definition of Division 2.1 or 2.3. [Ref 1]

(3) *Division 2.3 Toxic Gases (Gas poisonous by inhalation).* Any material which is a gas at 20 degrees C (68 degrees F) or less and a pressure of 101.3 kPa (14.7 psi) and is known to be so toxic to humans as to pose a hazard to health during transportation or in the absence of adequate data on human toxicity; it is presumed to be toxic to humans because of the results of animal laboratory tests. [Ref 1]

Gases in the three divisions can have any of the following characteristics:

(*Non-liquefied compressed gas*). Any gas, other than in solution, which in a packaging under the charged pressure is entirely gaseous at a temperature of 20 degrees C (68 degrees F). [Ref 1]

(*Liquefied compressed gas*). Any gas which in a packaging under the charged pressure is partially liquid at a temperature of 20 degrees C (68 degrees F). [Ref 1]

(*Compressed gas in solution*). Any non-liquefied

compressed gas which is dissolved in a solution. [Ref 1]

(*Cryogenic Liquid*). Any refrigerated liquefied gas having a boiling point colder than -90 degrees C (-130 degrees F) at 101.3 kPa (14.7 psi) absolute. It does not matter whether it meets the definition of non-flammable or non-poisonous compressed gases. [Ref 1]

### **3. Class 3 - Flammable Liquids**

A flammable liquid is any liquid having a flash point of not more than 60.5 degrees C (141 degrees F), or any material in a liquid phase with a flash point at or above 37.8 degrees C (100 degrees F) that is intentionally heated and offered for transportation or transported at or above its flash point in a bulk package. A flash point is defined as the minimum temperature at which a liquid gives off sufficient vapor in a test vessel to form an ignitable mixture with air. [Ref 1]

Frequently a distinction needs to be made between a flammable liquid and a combustible liquid. A combustible liquid is any liquid that does not meet the definition of any other hazard class and has a flash point above 60.5 degrees C (141 degrees F) and below 93 degrees C (200 degrees F). Diesel fuel, a commodity used in large quantities by the military, is an example of a combustible liquid.

### **4. Class 4 - Flammable Solids, Spontaneous Combustibles, and Dangerous When Wet**

(1) *Division 4.1 (Flammable Solids)* consists of any of the following three types of materials:

a. Wetted explosives are explosives that if dry would be part of class 1 other than those of compatibility group A (the thirteen compatibility group letters are used to specify controls for transportation and storage to prevent an increase in hazard that might result if certain types of explosives were stored or transported together), but for safety reasons are wetted and now have the hazardous properties of materials in division 4.1. This material is wetted with sufficient

water, alcohol, or plasticizer to suppress the explosive properties.

b. Self-reactive materials that are liable to undergo, at normal or elevated temperatures, a strongly exothermal decomposition caused by excessively high transport temperatures or by contamination.

c. Readily combustibles solids are materials that may cause a fire through friction. Matches are an example of this material as are any metal powders that can be ignited and react over the whole sample in ten minutes or less. Finally, a material with a burning rate faster than 2.2 mm (0.087 inches) per second as determined by prior testing falls into this category. [Ref 1]

(2) *Division 4.2 (Spontaneously Combustible Material)*  
This division consists of two categories, pyrophoric materials and self-heating material.

a. A pyrophoric material is a liquid or solid that, even in small quantities and without an external ignition source, can ignite within five minutes after coming in contact with air as determined by prior testing. [Ref 1]

b. A self-heating material is a material that, when in contact with air and without an energy supply, is liable to self-heat. A material of this type either exhibits spontaneous ignition or achieves a temperature exceeding 200 degrees C (392 degrees F) during a 24-hour period. [Ref 1]

(3) *Division 4.3 (Dangerous When Wet Material)*. This material, when contacted with water, is liable to become spontaneously flammable or to give off flammable or toxic gas at a rate greater than 1 liter per kilogram of the material per hour. [Ref 1]

## **5. Class 5 - Oxidizers and Organic Peroxides**

(1) *Division 5.1 (Oxidizer)*. An oxidizer is a material that may, generally by yielding oxygen, cause or enhance the combustion of other materials. Examples of oxidizers include

nitric acids and calcium hypochlorite. [Ref 3]

(2) *Division 5.2 (Organic Peroxide)*. This is any organic compound containing oxygen (O) in the bivalent -O-O- structure and which may be considered a derivative of hydrogen peroxide where one or more of the hydrogen atoms have been replaced by organic radicals. There are seven further classifications of organic peroxides A-G that are based on concentrations and detonation or explosionve potential. [Refs 1, 2]

## **6. Class 6 - Poisonous and Infectious Substances**

(1) *Division 6.1 (Poisonous Material)* This class consists of material, other than a gas, which is known to be so toxic to humans as to afford a hazard to health during transportation. This is based on known data or tests on laboratory animals. There are three types of toxicity, oral (ingestion), dermal (skin absorption) or inhalation of a dust or mist. Each of these toxicity types has different concentration criteria. Pesticides compose the largest commodity in this class. Examples of poisons include Parathion (a pesticide) and tetraethyl lead (a motor fuel antiknock compound). [Refs 1, 2, 3]

(2) *Division 6.2 (Infectious Substances)* This class, synonymous with etiologic agents, contains living microorganisms, or the toxins they produce, that may cause disease in humans and animals. These diseases in some cases are severe, disabling or fatal. Examples include diagnostic specimens (human or animal blood, tissues, secretions), biological products (prepared or manufactured in a lab or hospital) or regulated medical waste. [Refs 1, 2, 3]

## **7. Class 7 - Radioactive Materials**

Radioactive material is the most complex and highly regulated class. This class contains articles or substances which spontaneously and continuously emit ionizing radiation which can be harmful to health and can affect photographic or x-ray film. This radiation cannot be detected by any of the

human senses (sight, smell, hearing, touch or taste), but it can be detected and measured with suitable instruments.

[Refs 1, 2, 3]

To be classified as radioactive a material must have a specific activity (ion emitting rate) of greater than 0.002 microcuries per gram of material. Examples of radioactive material include radioactive iodine and cobalt (medical treatment) enriched uranium (fresh fuel element in nuclear power) and plutonium (waste material in nuclear power). [Refs 1, 2, 3]

Radioactive material is the only class to have entire chapters devoted to it in the 49 Code of Federal Regulations and the International Air Transport Association Dangerous Goods Regulation (IATA).

#### **8. Class 8 - Corrosives**

Corrosive material includes liquids and solids that cause visible destruction or irreversible alterations in human skin tissue at the site of contact, or a liquid that has a severe corrosion rate on steel or aluminum (6.25 mm or 0.246 inches per year at 55 degrees C or 131 degrees F). [Refs 1, 2, 3]

Examples include acids such as sulfuric acid (chemical processing and manufacturing) and bases such as potassium hydroxide (production of soft or liquid soaps) or alkaline battery fluid (car batteries).

#### **9. Class 9 - Miscellaneous**

This classification covers material that poses a hazard during transportation but does not meet the definition of any other hazard class. This material can have anesthetic, noxious or other similar properties which could cause extreme annoyance or discomfort to passengers and/or flight crew members. [Refs 1, 2, 3]

Magnetized material also falls in this class. A material is considered magnetized if when packed for air transport, it has a magnetic field strength of 0.159 A/m (0.002 gauss) or

more at a distance of 2.1 m (7 ft) from any point on the surface of the assembled package. [Ref 1]

Another group of materials in the miscellaneous class is "Other Regulated Materials" or "ORM-D". ORM-D is generally a consumer quantity packed for retail sale or personal consumption. Cosmetics, bug sprays and disposable lighters are examples. While meeting the definition of a hazardous material, these items presents a limited hazard during transportation because of their form, quantity, and packaging. Not all hazardous materials are eligible for ORM-D status and those that are need to meet various levels of criteria.

#### **10. Hazardous Substances**

The United States government defines a hazardous substance as any substance which, if spilled, would adversely affect the environment. Per package limits are established by the Environmental Protection Administration (EPA) and are called the "Reportable Quantity" or "RQ". [Ref 3]

Reportable Quantity is defined as the minimum amount of a substance that would affect the environment significantly enough to warrant reporting if spilled. The "RQ" follows the proper shipping name on all documentation and packaging and the aircraft commander must be aware that he is carrying such cargo. [Refs 2, 3]

#### **11. Hazardous Waste**

Hazardous waste is any regulated substance described or identified by the shipper as "waste" on a hazardous waste manifest as required by EPA regulations. Often expired material or the remains after normal use, this material can adversely affect the environment if mishandled. Hazardous waste is not transported by aircraft.

#### **12. Multi-Class Materials**

Frequently, materials will have properties which meet the definition of two or more classes. In such cases the shipper must classify the material according to the hazard ranking

found in the regulations. This then becomes the "basic hazard classification" of the material which must appear on the shipping papers and is used to determine placarding (warning signs on the transportation conveyance or parking area). Other hazards which the material possesses will be identified by labels applied to the package. The list below ranks the five most serious degrees of hazardousness in descending order of priority when shipping materials with multiple hazards.

1. Class 7 (radioactive materials unless the amount is considered a limited quantity).
2. Division 2.3 (poisonous gases).
3. Division 2.1 (flammable gases).
4. Division 2.2 (nonflammable gases).
5. Division 6.1 (poisonous liquids). [Ref 1]

#### **B. PROCEDURES FOR SHIPPING HAZARDOOUS MATERIALS**

##### **1. Selecting the Proper Shipping Name**

In order to determine the correct hazard class to use, the commodity to be shipped must be assigned one of the standard names used to transport dangerous goods. These names are called "proper shipping names". Once you have determined the proper shipping name, you can look up the article or substance in the Hazardous Materials Table (HMT) found in the 49 CFR or the List of Dangerous Goods contained in the IATA.

It is not always easy to identify whether the commodity being considered for transport is hazardous or not. Numerous brand names and industry trade names blur the identity. A review of the list of active ingredients is required. Additionally, new products are constantly being developed by industry. Once an item is identified, it is given a United Nations (UN) or North America (NA) identification number which can be cross referenced to the nomenclature listed on the Hazardous Materials Table. As the name implies, items with "NA" can only be shipped domestically, or to and from Canada.

Sometimes the proper shipping name is not specific, but



more correctly described by a group of materials having the same traits. These materials are identified by the all-encompassing phrase "not otherwise specified" or "n.o.s.". The following order of classification preference is used to describe "not otherwise specified" articles or substances:

- generic chemical, e.g., Alcohols, n.o.s.
  - generic use, e.g., Dyes, solid, n.o.s.
  - hazard description, e.g., Flammable liquid, n.o.s.
- [Ref 2]

As can be seen, every effort should be made to be as specific as possible.

## 2. Packaging or Packing

While not as scientifically complex as deriving a shipping name for an unknown article or substance, the area of packaging is full of instructions and requirements. The packaging section comprises the largest portions of the IATA, 49 CFR and AFR 71-4 / NAVSUP PUB 505.

The fundamental premise of packaging is that the shipper is responsible for providing a commodity made ready for safe transportation by following the provisions of applicable regulations. The Hazardous Material Transportation Uniform Safety Act of 1990 (HMTUSA), designed to bring United States hazardous material regulations into agreement with the United Nations International recommendations, contained docket number HM-181 which drastically altered long held packaging paradigms. "No longer does the United States Department of Transportation provide package specifications for individual commodities. Rather, they require dangerous goods packaging to pass performance tests that simulate the stresses encountered during transportation." [Ref 4]. The conditions of normal air transportation are such that the shipper needs to consider extreme temperature ranges (-40 degrees F to 130 degrees F), pressure reductions due to altitude changes, and vibration factors brought on by take-off and landing as well as air turbulence. [Ref 2] These performance oriented

packaging regulations require successful tests in four areas in order to win U.N. approval: drop, hydrostatic, "leakproofness," and stacking (compression). [Ref 4] The United Nations recommendations are not regulations but they have been adopted by regulatory bodies such as the International Civil Aviation Organization (ICAO) which publishes the IATA.

A major change pursuant to performance oriented packaging is the use of packing groups. "Packaging requirements are established for each group based on the material, its vapor pressure and its compatibility with the packaging material". [Ref 5] Packaging Group numbers I, II or III are assigned to dangerous goods in classes 3, 4, 5, 6, 8 based on specific criteria. Criteria have not yet been developed for class 9, but goods in this class have been assigned groups based on experience and knowledge. Packing Groups are assigned according to the relative degree of danger presented by the article or substance:

*Packing Group I* indicates a high degree of danger.

*Packing Group II* indicates a medium degree of danger.

*Packing Group III* indicates a minor degree of danger.

[Ref 2]

A common means of transporting air cargo is via shipping containers frequently referred to as "igloos" or on aluminum pallets secured with netting or shrinkwrap. Igloos are used extensively in the civilian sector and are so called because of their configuration which fits nicely into the cargo holds of aircraft. These containers may contain dangerous goods from the various hazard classes as long as segregation rules are followed along with reactivity and quantity restrictions.

The example of the use of packing groups and how they apply to containerized loads presented in Table 2 was extracted from the IATA Dangerous Goods Regulation which describes the requirements for absorbent materials.

	Passenger Aircraft	Cargo Aircraft Only
Packing Group I	A	B
Packing Group II	B	C
Packing Group III	C	C

Table 2. Packing Groups and Corresponding Absorbent Material  
From Ref. [2]

Cargo Aircraft Only refers to just that, an aircraft devoid of passengers and occupied only by a flight crew. Greater risks can be assumed in the absence of passengers.

- A - Sufficient absorbent material to absorb the contents of all inner packagings.
- B - Sufficient absorbent material to absorb the contents of any one inner packaging; and where the inner packagings vary in size, enough to absorb the contents of the inner packaging containing the greatest quantity of liquid.
- C - No absorbent material required.

As you can see, substances in Packing Group I require much greater precautions than those in Packing Group III. As another example of packing group classifications, let us look at class 3 - Flammable Liquids.

Flammable liquids are separated into packing groups based on their flash point and boiling point. Table 3, also taken from the IATA Dangerous Goods Regulation, depicts the breakdown.

<u>PACKING GROUP</u>	<u>FLASH POINT</u>	<u>BOILING POINT</u>
I	-	less or equal to 35 degrees C
II	less than 23 degrees C 73 degrees F	greater than 35 degrees C
III	equal to or greater than 23 degrees C but less than 60.5 degrees C	greater than 35 degrees C

Table 3. Packing Groups Based on Flammability From Ref. [2]

Special considerations are given to packaging described as "empty". An "empty" package, container or cylinder is one which previously contained a hazardous material. If the container has any residue at all, it must be shipped using the hazard class of the previous contents and the word "empty" must appear on the Shipping Declaration in place of the quantity. [Ref 2] If it has been completely purged of all remnants, no Shipper's Declaration for Dangerous Goods is required, only an "empty" label on the package. This is particularly pertinent in the case of aircraft engines shipped by the DOD. An engine that has not been drained and purged can emit more noxious fumes than one which is 95% full.

Ultimately, as stated earlier the shipper must use only the permitted packaging for the commodity being shipped and comply fully with the packaging requirements delineated in the reference publication.

### **3. Marking and Labeling**

#### **a. Marking**

Marking on a package or overpack (a second package enclosing the first used for consolidation or protection) identifies to all interested parties all pertinent data specific to the safe handling of the hazardous materials contained therein. Once again the shipper is responsible for marking the package in compliance with applicable regulations. The package must be of such a size that there is adequate space for all labelling and marking. Regulations specify that the markings on the package must provide adequate permanency and contrast so as to be readily visible. Markings not relevant to the dangerous goods package or overpack should be removed or obliterated. Specification markings are not required for packages containing Limited Quantity shipments. If an overpack is used, the required markings must be readily visible or reproduced on the outside. All packaging must be marked with at least the following:

1. Proper shipping name
2. UN or NA number
3. Name and address of the shipper and consignee

#### **b. Labeling**

All classes of dangerous goods require the use of hazard labels. Labels are the primary means by which dangerous goods shipments can be easily identified. Although similar in color and shape, labels differ from placards (discussed in the next section) in one key way. Labels are applied to packages such as boxes and drums and placards are applied to transport vehicles such as trucks and rail cars. [Ref 3] Shippers are responsible for removing or obliterating any irrelevant label(s), inscribing any required additional information, and affixing the proper label in a durable manner and in the correct location. Occasionally, dangerous goods may have primary and subsidiary (secondary) risks. When this

occurs only the label dictating the primary risk can have the hazard number on the bottom portion. [Ref 1] As an example consider tripropylamine. It is a flammable liquid in hazard class 3 but has the subsidiary hazard of being corrosive. A package containing tripropylamine would contain two labels, a red flammable liquid label with the number 3 at the bottom and a white and black corrosives label.

Specific to air transportation because of the potential havoc caused to navigation equipment, shipments containing magnetized material require the use of the Magnetized Label in lieu of the class 9 hazard label. Liquid dangerous goods must utilize the Package Orientation (This Way Up) label with a few exceptions.

Correct labeling procedures include:

- All labels must be securely affixed and be completely visible.
- Labels cannot be folded or affixed in such a manner that parts of the same label appear on different sides of the package. It is permissible to attach the label by means of a strong tag to avoid overlapping.
- All labels should be placed as near as possible to the shipper's or consignee's address appearing on the package.
- When package orientation labels are used, place identical labels on opposite sides of the package.  
[Ref 2]

#### **4. Placarding**

Each motor vehicle, rail car, and freight container containing hazardous materials must be placarded on each end and on each side with a placard detailing the hazard class. Placards are not required on transport vehicles hauling limited quantities of hazardous materials. Aircraft do not require placarding except for large freight containers containing radioactive materials. United Parcel Service posts the Shippers Declarations on the side of their air containers

in transparent plastic pouches to facilitate hazardous material identification. [Ref 8]

#### 5. Documentation - Shipping Papers

A "Shipper's Declaration for Dangerous Goods" and an Air Waybill are required for each shipment of dangerous goods unless especially excepted. While there is no specific United States government form required to be used for the shipment of hazardous materials, key entries must be included on the document selected for use. The declaration form must be of the correct design and format and completed accurately and legibly. The form must be properly signed when the shipment is presented to the airline for shipment. The declaration form must be prepared in English, although a supplemental printed, foreign language translation may also appear. The declaration form may be printed in black and red on white paper, or it may be printed in red only on white paper. The form must always contain red diagonal hatchings printed vertically in the left and right margins. [Ref 7] Figure 1, found in the IATA Dangerous Goods Regulation, is an example of a Shipper's Declaration for Dangerous Goods.

The IATA Dangerous Goods Regulation provides the following guidance regarding air shipments containing both hazardous materials and general cargo.

When an Air Waybill contains both dangerous goods and non-dangerous goods, the dangerous goods must be shown first. Air Waybills accompanying dangerous goods consignments must include one or more of the following statements, as applicable, in the Handling Information box:

- Dangerous goods as per attached Shippers declaration;
- Dangerous goods - Shipper's Declaration not required;
- Cargo Aircraft Only. [Ref 2]

Shipper		Air Waybill No. Page      of      Pages Shipper's Reference Number  (optional)		
Consignee		For optional use for Company logo name and address		
Two completed and signed copies of this Declaration must be handed to the operator		<b>Warning</b> Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstance, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.		
<b>TRANSPORT DETAILS</b>				
This shipment is within the limitations prescribed for: (delete non-applicable)				Airport of Departure
PASSENGER AND CARGO AIRCRAFT	CARGO AIRCRAFT ONLY			
Airport of Destination:		Shipment type: (delete non-applicable)		
		NON- RADIOACTIVE	RADIOACTIVE	
<b>NATURE AND QUANTITY OF DANGEROUS GOODS</b> Proper Shipping Name, Class, UN Number or Identification Number, number of packages, packing instructions and all other required information as detailed in Subsections 6.6 and 8.1 of IATA Dangerous Goods Regulations.				
----- Additional Handling Information				
I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labelled, and are in all respects in the proper condition for transport by air according to the applicable international and national government regulations.		Name/Title of Signatory  Place and Date  Signature  <small>(see warning above)</small>		

Figure 1. Shipper's Declaration for Dangerous Goods



If a Shipper's Declaration is not required for dangerous goods, the Nature and Quantity of Goods box of the Air Waybill must show in sequence these key items found on the Shipper's Declaration:

- proper shipping name;
- class or division number;
- UN or ID number;
- subsidiary risk, if any;
- number of packages;
- net quantity per package;
- packing instruction;
- packing group. [Ref 2]

#### C. SUMMARY

This chapter introduced the various types of hazardous materials, their corresponding assigned classes, and the basic terminology used in the transportation of hazardous materials. This highly technical information will be referred to frequently throughout this thesis as the regulations, instructions, manuals, training programs and standard operating procedures of the Department of Defense and the commercial airline industry are examined.

### III. TITLE 49 CODE OF FEDERAL REGULATIONS

#### A. BACKGROUND

The Code of Federal Regulations (CFR) is divided into 50 titles representing broad areas that are regulated by the Federal government. Title 49 of the code is related to transportation. Published by the Office of the Federal Register, National Archives and Records Administration, each of the 50 volumes is revised annually. There are no restrictions on the republication of material appearing in the Code of Federal Regulations, hence numerous sections are extracted for inclusion in various training manuals.

Title 49 Code of Federal Regulations describes itself this way in an introductory paragraph:

Title 49 - TRANSPORTATION is composed of seven volumes. The first volume (parts 1-99) contains the current regulations issued under subtitle A - Office of the Secretary of Transportation. It is the second volume (parts 100-177) which contains the current regulations issued under chapter 1 - Research and Special Programs Administration (DOT) that governs hazardous material transportation.  
[Ref 1]

Regulations governing the transportation of hazardous materials via all modes are included. Chapter 1, which encompasses the entire volume, is sub-sequently divided into subchapters, parts, subparts and numbered paragraphs. Figure 2 depicts the layout of the major sections.

#### B. GENERAL SYNOPSIS

Chapter 1 - Research and Special Programs Administration, Department of Transportation begins with the rule making procedures used by the Research and Special Programs Administration of the Department of Transportation which is the agency responsible for the regulations found in this code.

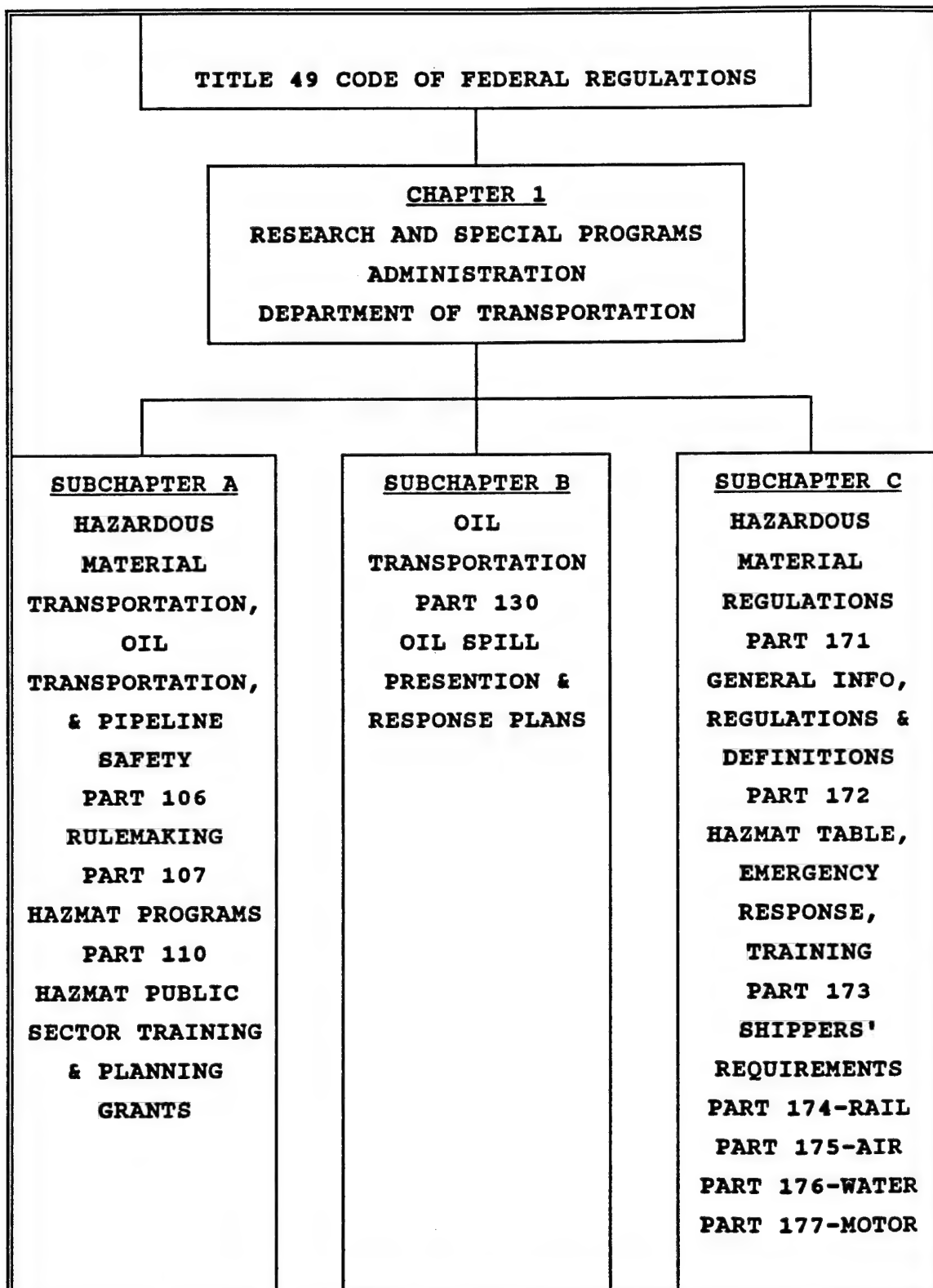


Figure 2. Title 49 Code of Federal Regulations Organization

**Subchapter A - Hazardous Materials Transportation, Oil Transportation and Pipeline Safety - Part 107 - Hazardous Materials Program Procedures** This section commences the dissemination of information pertinent to this paper.

**Subpart A - General Provisions.** Subpart A provides legal definitions ranging from "Indian tribe" to "person" (individual, firm, corporation etc.), procedures dealing with the service of subpoenas, the use of agents by non-US residents and other legal matters. Full of legal jargon, this regulation is not easy for a layman to understand.

**Subpart B - Exemptions.** This section provides the prescribed procedures by which persons can request administrative relief from the provisions of this regulation. The requirements to receive an exemption are spelled out this way:

Persons who are subject to the requirements of this and other subchapters may obtain administrative relief therefrom on the basis of equivalent levels of safety or levels of safety consistent with the public interest and the policy of the Hazardous Materials Transportation Act. [Ref 1]

This subpart describes the application process, requests for emergency exemptions, application withdrawals and appeals. If and when packaging exemptions are granted, the outside of each package must plainly and durably be marked "DOT-E" (Department of Transportation - Exemption) followed by the number assigned.

Exemptions are granted to shippers and carriers in all transportation modes. Within the airline industry, permission can be given for flights of "cargo only aircraft" provided the following provisions are met:

- only air crew personnel, FAA inspectors, or persons associated with ownership or handling of the material are permitted on the aircraft.

- the operator of the aircraft must obtain advanced permission from all involved airports to take off and land.
- after airport permission is granted designated loading and unloading sites must be strictly complied with.
- if the hazardous material is especially dangerous, airports selected for use should be a safe distance from heavily populated areas.
- each crewmember of the aircraft must be provided written instructions on the conditions and limitations of the operations to be conducted.
- the FAA Civil Aviation Security Office must approve the aircraft and the loading arrangements.
- when certain explosives are carried, the aircraft flight route will avoid heavily populated areas commensurate with flight safety. [Ref 1]

Commercial airlines under charter contract to the Department of Defense operate under DOT exemptions 7573 and 9232. DOT-E 7573 applies to channel (regularly scheduled route) movement of hazardous material shipments by approved cargo carriers contracted to the Air Mobility Command (AMC). DOT-E 9232 is used only during a declared national emergency or crisis condition. In such an emergency the Civil Reserve Air Fleet (CRAF) is activated, and there is often a rapid mobilization of the armed forces. The United States government may even receive the loaned use of foreign aircraft. [Ref 10] These exemptions allow the air carriers to meet the less stringent requirements of the Department of Defense hazardous material air transportation regulation, the AFR 71-4. This regulation and its revision, the Air Force Joint Manual 24-204, are examined in Chapters VI and VII of this thesis.

**Subpart C - Preemption.** This section deals with preemption (where another regulation takes precedence) in a

manner similar to exemption. For example, Indian reservations have laws specific to themselves which preempt state and federal regulations.

**Subpart D - Enforcement.** Under delegation from the Administrator, Research and Special Programs Administration, the Associate Administrator for Hazardous Material Safety and the Office of the Chief Counsel share exercise authority for enforcement of the Title 49 Code of Federal Regulations. At their disposal are such tools as warning letters and notices of probable violations. To incur a violation, the offender must have "acted knowingly" which also includes failing to act. Failing to act occurs when a "person" having such knowledge as a reasonable person should in a given circumstance fails to exercise the due care required to prevent the violation.

Included in the "notice of probable violation" is the dollar amount of the proposed fine and a declaration of the corrective action required to be taken. The offender has 30 days to reply. They can reply by admitting guilt, providing a written explanation of their side of the story, or by requesting a hearing before an Administrative Law Judge (ALJ). At any time before the ALJ decision, compromise and settlement is permitted. Written appeals to the ALJ decision are permitted. The maximum civil penalty currently stands at \$25,000 per day.

Section 107.331 lists the assessment considerations used in imposing civil penalties. They are:

- The nature and circumstances of the violation;
- The extent and gravity of the violation;
- The degree of the respondent's culpability;
- The respondent's history of prior offenses (violations);

- The respondent's ability to pay;
- The effect on the respondent's ability to continue in business; and
- Such other matters as justice may require.

Criminal penalties which can add up to 5 years in prison to the already levied fine are available for those violators determined to be "willful". Section 107.337 discusses injunction action which forbids a person from engaging in action that violates the provisions of this regulation. This is especially pertinent in the case of "Imminent Hazard" where there is a "substantial likelihood that death, serious illness, or severe personal injury will result if the transportation is allowed to happen.

**Subpart E - Designation of Approval and Certification Agencies** This section "establishes procedures for the designation of agencies to issue approval certificates and certification for types of packaging designed, tested or manufactured in conformance with United Nations' recommendations.

**Subpart F - Registration of Cargo Tank Motor Vehicle Manufacturers and Repairers and Cargo Tank Motor Vehicle Assemblers and Subpart G - Registration of Persons Who Offer or Transport Hazardous Materials** In addition to registration, a fee payment is required of all persons who engage in the transport of hazardous materials in foreign, interstate or intrastate commerce. Various quantity thresholds must be exceeded before registration is necessary. State and Federal agencies are excepted from the registration and \$300 fee as are persons domiciled outside the United States who transport between two points outside the United States. Foreign subsidiaries of United States corporations fall in this category.

**Subchapter A - Part 110 - Hazardous Materials Public Sector Training and Planning Grants** This part describes the requirements to be met and the procedures to be followed in order for states and Indian tribes to receive federal funding to support hazardous materials emergency response training and planning efforts.

**Subchapter B - Part 130 - Oil Transportation** Prevention of oil mishaps such as the Exxon Valdez tragedy, as well as the oil spill emergency response requirements of the Department of Transportation are contained in this section. It includes definitions, quantity thresholds, communications, packaging and response plan requirements.

**Subchapter C - Part 171 - Hazardous Materials Regulations** Note that there is a gap in the sequential numbering between Subchapters B and C. Subchapter C is the heart of the regulation. It delineates the requirements for the transportation of hazardous materials by rail, aircraft, vessel and motor vehicle.

After reiterating the requirements and definitions cited earlier, a listing of reference material appears. The reference materials listed are considered incorporated into the Code of Federal Regulations. Such work includes published results from the American Society for Testing and Materials, the American National Standards Institute and the Compressed Gas Association, Inc. These organizations provide the data upon which the regulations are derived.

Following these reference materials, paragraph 171.8 provides ten pages of definitions ranging from a simple "box" to "W.T." meaning watertight. Paragraph 171.9 contains more legalese with a discussion of the use and meaning of "shall," "must," "should" or "may" as they appear throughout the regulation as well as other unique word meanings. Paragraph 171.10 comprises information pertaining to the units of measure. A table compares international and United States



standards in the areas of length, thickness, mass (weight), pressure, volume (liquid) and density. The use of the International Commercial Airlines Organization (ICAO) technical instructions is described in paragraph 171.11. Basically, it states that because the ICAO regulations are stricter, they can be used to certify all multi-modal transport which encompasses air during some leg. It is rare to find material transported only by aircraft. Normally, truck transportation is necessary at one or both ends.

After a discussion of United States hazardous material import/export requirements in paragraph 171.12, a thorough schedule is delineated for compliance transitioning to the new United Nations recommendations. Paragraph 171.14 discusses UN mandated packaging changes incorporated into docket HM-181 of the Hazardous Materials Transportation Uniform Safety Act of 1990 (HMTUSA). Effective October 1, 1994 as part of the shift to Performance Oriented Packaging (POP), DOT specified packaging may no longer be manufactured. Only packaging meeting UN standards will be allowed. There will be a two year transition period permitted so that manufacturers and shippers can deplete their stock of DOT packaging. Paragraph 171.15-16 describes the who, what, when, where and how of hazardous materials incident reporting procedures including the recent changes mandated by HMTUSA. A placard substitution table is provided, as reproduced in Table 4, comparing the specifications in effect on September 30, 1991 with the new UN standards.

Hazard Class or Division Number	Current Placard Name	Old (Sept. 30, 1991) Placard Name
Division 1.1	Explosives 1.1	Explosives A.
Division 1.2	Explosives 1.2	Explosives A.
Division 1.3	Explosives 1.3	Explosives B.
Division 1.4	Explosives 1.4	Dangerous.
Division 1.5	Explosives 1.5	Blasting Agents.
Division 1.6	Explosives 1.6	Dangerous.
Division 2.1	Flammable gas	Flammable gas.
Division 2.2	Nonflammable gas	Nonflammable gas.
Division 2.3	Poison gas	Poison gas.
Class 3	Flammable	Flammable.
Combustible Liquid	Combustible	Combustible.
Division 4.1	Flammable Solid	Flammable Solid.
Division 4.2	Spontaneously Combustible	Flammable Solid.
Division 4.3	Dangerous when wet.	Flammable solid W.
Division 5.1	Oxidizer	Oxidizer.
Division 5.2	Organic peroxide	Organic peroxide.
Division 6.1, PG I and II	Poison	Poison.
Division 6.1, PG III	Keep away from food	(none required).
Class 7	Radioactive	Radioactive.
Class 8	Corrosive	Corrosive.
Class 9	Class 9	(none required.)

Table 4. Placard Substitution Table From Ref. [7]

## **C. HAZARDOUS MATERIAL TABLE**

### **Subchapter A - Part 172 - Hazardous Materials Table, Special Provisions, Hazardous Materials Communication, Emergency Response Information, and Training Requirements**

Encompassing 337 pages, this is the largest portion of the regulation and the section that details the concepts of marking, labeling, placarding and packaging described in chapter two of this thesis.

Following a table of contents is a 17 page Identification Number Cross Reference Index to Proper Shipping Names. Compiled and updated by the Research and Special Programs Administration, Department of Transportation, it provides a two column listing in ascending order of United Nations identification numbers and the corresponding material description. For example:

UN0074 - Diazodinitrophenol, wetted

Next is the most important part of the regulation, **Subpart B - Table of Hazardous Materials and Special Provisions**. Comprising 200 pages, this 10 column table contains a list of those materials which have been designated by the United States Department of Transportation (DOT) as hazardous materials for the purpose of being transported in commerce and gives specific information regarding how to move the material safely. Table 5 depicts a one line excerpt from the Hazardous Materials Table found in volume 49 of the Code of Federal Regulations. Space limitations require that the example entry be broken into two lines.

Sym-bols	Hazardous materials descriptions and proper shipping names	Hazard class or Division	Identification Numbers	Pack-ing group	Label(s) req (if not excepted)
(1)	(2)	(3)	(4)	(5)	(6)
A	Acetaldehydeammonia	9	UN 1841	III	Class 9

Special Provisions (7)	(8) Packaging authorizations (para 173.***			(9) Quantity limitations		(10) Vessel stowage requirements	
	Ex-ceptions (8A)	Non-bulk pack-aging (8B)	Bulk pack-aging (8C)	Passenger aircraft or railcar (9A)	Cargo air-craft only (9B)	Vessel stow-age (10A)	Other stowage provi-sions (10B)
	155	204	241	200kg	200kg	A	34

Table 5. Hazardous Materials Table After Ref. [1]

In the hazardous materials table, Column (1) **Symbols** delineates the mode or modes by which the material is regulated and addresses other issues. This column, used less than 10% of the time, may contain one or more of five possible characters. In the example presented in Table 5, the letter "A" restricts the application of the requirements to materials offered or intended for transportation by aircraft. For other modes of transportation the material is not regulated. A "+" arbitrarily assigns a material to a specific hazard class or packing group regardless of whether it meets the definition of

that group. It is a best fit classification. The letter "W" restricts the application of the requirements to vessels. When the letter "D" appears, it means that the proper shipping name is appropriate for domestic transportation but may not be acceptable for international transportation. The letter "I" indicates the required proper shipping name for materials transported internationally. An alternative proper shipping name may be used when only domestic transportation is involved. [Ref 1]

Column (2) **Proper Shipping Name** contains an alphabetical listing of the proper shipping name that must appear on the shipping papers, be marked on the package and entered on certain other documents. The shipper must use the hazardous material description in Column (2) which most appropriately describes the hazardous material being shipped. He can not opt to use the N. O. S. (not otherwise specified) category if he can narrow down the commodity.

Column (3) **Hazard class or division** contains the hazard class or division of the material as it must appear on the shipping papers. Occasionally, the word "Forbidden" will appear indicating the material may not be offered or accepted for transportation.

Column (4) **Identification number** contains a four digit number assigned to each proper shipping name. When the numerals are preceded by the letters "UN" it means that the proper shipping name has been approved by the United Nations for use in international as well as domestic transportation. When the identification number begins with "NA", the proper shipping name is authorized for shipping hazardous materials in North America excluding Mexico. [Ref 1]

Column (5) **Packing groups**, as described in Chapter II of this thesis indicate the degree of danger presented by the material. Column (5) specifies one or more packing groups which have been assigned to a particular hazardous material.

[Ref 1]

Column (6) **Labeling** contains a listing of the label(s) required for a particular hazardous material. On occasion column (6) will indicate "none" meaning that no label is required. In certain instances, the labeling requirements of the Hazardous Materials Table are overridden by provisions of the packaging section, particularly with regard to limited quantities.

Column (7) **Special Provisions** is used frequently. When an entry is found in this column, either numbers or alphanumeric combinations, reference must be made to subpart 172.102 for an explanation of the additional transportation requirements.

Columns (8A) **Exceptions**, (8B) **Non-bulk packaging** and (8C) **Bulk packaging** fall under the title **Packaging authorizations**. Numbers or the word "none" appear in these columns and are appended to paragraph 173 of 49 CFR. Using the example of acetaldehydeammonia presented in Table 5, non-bulk shipments of acetaldehydeammonia must be shipped according to the regulations of paragraph 173.204, bulk shipments according to 173.241 and packaging regulations are excepted if the shipment meets the requirements of paragraph 173.155.

Column (9) **Quantity limitations** provides the maximum net quantity that can be contained in one package for shipment in either passenger aircraft/rail car or cargo only aircraft. Generally, there is no restriction on the maximum number of packages of hazardous material contained on a transport vehicle as long as compatibility and segregation standards are met.

Column (10) **Vessel stowage requirements** specifies the authorized stowage locations on board cargo and passenger vessels. Composed of five categories, lettered "A"-"E", the primary purpose of this classification system is to provide accessibility to the hazardous material in the event of an

emergency.

**Appendix A** to the Hazardous Materials Table in Part 172 lists hazardous substances and their corresponding reportable quantities as designated by the Environmental Protection Administration (EPA). This appendix consists of a three column, 43 page table that lists the hazardous substance, its synonyms and the reportable quantity in both pounds and kilograms. If, when shipping one of these listed substances, the amount in the package equals or exceeds the reportable quantity listed for the substance, the shipper must provide additional information. Of the over 1000 materials listed in the appendix, over 400 have reportable quantities of 10 pounds or less. To prevent heavy fines, it is imperative that the shipper consult this appendix. **Appendix B** to the Hazardous Materials Table provides a list of "marine pollutants".

**D. SUBPART C - SHIPPING PAPERS, SUBPART D - MARKING,  
SUBPART E - LABELLING, SUBPART F - PLACARDING**

Similar in content to the information provided in chapter II of this thesis, this section explains how to properly complete the shipping papers, shipper's certifications and hazardous waste manifests as well as promulgating rules pertaining to marking, labelling and placarding.

**E. SUBPART G - EMERGENCY RESPONSE INFORMATION**

Recently amended by docket number HM-126 of the HMTUSA, this section focuses primarily on the communication of hazardous material information. Its provisions require that shippers describe "n.o.s." items more completely on shipping papers and in package markings. There is now a requirement for more emergency response information on shipping documents including a 24-hour telephone contact number. The person manning the phone must be knowledgeable about the hazardous materials being shipped and must be able to provide

information about emergency response and incident mitigation. This section applies not just to the shipper of hazardous materials but to carriers, warehouses and storage facilities as well. [Ref 6]

#### **F. SUBPART H - TRAINING**

Also amended by HM-126, this section mandates that any person directly or indirectly responsible for the safety of dangerous goods in the transportation system must be trained, tested and certified. Training must include general awareness and familiarization, specific job function training, and safety training. Each employee who works around hazardous materials must be recertified at least every two years. Each new employee hired after July 2, 1993 must complete training within 90 days of employment. Record keeping requirements are found in paragraph 172.204.

#### **G. SUBCHAPTER C - PART 173 - SHIPPERS' GENERAL REQUIREMENTS FOR SHIPMENTS AND PACKAGINGS**

Comprising 226 pages, Part 173 provides detailed packaging instructions for all materials listed in the Hazardous Materials Table. The primary contents are "packaging paragraphs" which provide great detail concerning how to package hazardous materials. Let us turn again to the example commodity acetaldehydeammonia. The Hazardous Materials Table calls for non-bulk quantities to be packaged according to paragraph 173.204. Paragraph 173.204 reads as follows:

When paragraph 172.101 (The Hazardous Materials Table) of this subchapter specifies that a liquid or solid hazardous material be packaged under this section any appropriate non-bulk packaging which conforms to the general packaging requirements of subpart B of part 173 may be used for its transportation. Packagings need not conform to the requirements of part 178 of this subchapter.



What this "packaging paragraph" means is that there is no specific requirements pertaining to non-bulk shipments of the material. Regardless of whether there are specific requirements, all packages of hazardous material must meet certain general packaging requirements. Section 173.24 prescribes such standard guidance and is contained in subpart B of part 173. More than one hazardous material can share the same "packaging paragraph". The "packaging paragraph" pertaining to the bulk shipment of acetaldehydeammonia is 173.241 and reads as follows:

When paragraph 172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of part 173 of this subchapter and the special provisions specified in column 7 of the 172.101 Table.

- a) Rail cars: Class DOT 103, 104, 105, 109, 111, 112, 114, or 115 tank car tanks; Class 106 or 110 multi-unit tank car tanks and AAR Class 203W, 206W, and 211W tank car tanks.
- b) Cargo tanks: DOT specification MC300, MC301, MC302, MC 303, MC304, MC305, MC306, MC307, MC310, MC311, MC312, MC330, MC331, DOT 406, DOT 407, and DOT 412 cargo tank motor vehicles; and non-DOT specification cargo tank motor vehicles suitable for transport of liquids.
- c) Portable tanks: DOT 51, 52, 56, 57 and 60 portable tanks; IMO type 1, 2 and 5, and IM 101 and IM 102 portable tanks; marine portable tanks conforming to 46 CFR part 64; and
- non-DOT specification portable tanks suitable for transport of liquids.

The last sentence, "and non-DOT specification portable tanks suitable for transport of liquids" represents the recent change to "performance oriented packaging" instituted by Docket number HM-181 of the Hazardous Materials Transportation Uniform Safety Act of 1990 (HMTUSA). Under this act, shippers become responsible for the suitability of their own packaging. After October 1, 1996, the Department of Transportation will no longer tell the shipper what type packaging to use for their products. All packaging will be required to meet United

Nations recommended performance standards related to drop, leakage, hydrostatics, compression and vibration. [Ref 6]

#### **H. SUBCHAPTER C - PART 174 - CARRIAGE BY RAIL**

This section discusses hazardous material issues unique to railroads. All provisions of parts 171, 172 and 173 need to be observed as well as the requirements of this section. Examples of rail unique issues include the inspection and cleaning of tank cars, attending to leaking tank cars, accounting for material sidetracked in "astray shipments", inspection requirements at interchanges and explosives loading in boxcars.

#### **I. SUBCHAPTER C - PART 175 - CARRIAGE BY AIRCRAFT**

Comprising only 20 pages and similar in format and scope to the rail carriage section described above, carriage by aircraft provides requirements specific to airline industry operations within the United States. There is a paragraph pertaining to the requirement for passenger notification regarding the transport of hazardous materials in baggage and on one's person at ticket counters and baggage check areas. Other paragraphs provide stowage compatibility charts and discrepancy and incident reporting procedures. Special handling procedures for poisons and radioactive materials are also described.

#### **J. SUBCHAPTER C - PART 176 - CARRIAGE BY VESSEL**

Carriage by Vessel begins with a list of definitions specific to water freight transportation. These include such nautical terms as "explosive anchorage," "hold," "magazine" and "crew living quarters". Part 176 talks about the Coast Guard's role in inspecting vessels to determine their suitability for loading hazardous materials cargo. A large section is dedicated to stowage and segregation requirements.

There is also extensive discussion of inland water towboat operations and ferry operations. The latter two vessel types do not load hazardous material directly but transport conveyances which carry the dangerous goods.

**K. SUBCHAPTER C - PART 177 - CARRIAGE BY PUBLIC HIGHWAY**

Because hazardous material travelling on the nation's highways poses the greatest risk to the general population, a large portion on Part 177 involves accident reporting procedures for the various hazard classes and divisions. Driver training programs, precautions to be taken when transiting vehicular tunnels as well as segregation and separation regulations are covered in detail.

#### IV. THE INTERNATIONAL AIR TRANSPORT ASSOCIATION DANGEROUS GOODS REGULATION

##### A. BACKGROUND

The International Air Transport Association (IATA) Dangerous Goods Regulation is an annual publication now in its 35th edition. Planning for the first edition began in 1953 when member airlines of the IATA recognized a growing need for policies and procedures designed to protect the safety of passengers, crews and aircraft from potential hazardous materials mishaps.

The regulation supplies air carriers and shippers with the technical data needed to comply with government regulations and airline industry standards. This data is compiled from the Technical Instructions for the Safe Transport of Dangerous Goods by Air, which is published by the International Civil Aviation Organization (ICAO). ICAO is an organization of the United Nations and is recognized as the final authority regarding the transportation of dangerous goods anywhere in the world.

Published in four languages; English, French, German and Spanish; the IATA Dangerous Goods Regulation has been refined over the years and is easy to use and readily understandable. Where there are ambiguities or nuances between the translations, the English version takes precedence.

Additionally, "variations" are published by nations and air carriers to ICAO regulations and are included in section 2.9 of this regulation. These deviations are permitted as long as they provide stricter rules than what normally would have been found in the regulations. Unlike Title 49 Code of Federal Regulations, hazardous materials and substances listed in the publication are referred to as "dangerous goods." The publication deals with every aspect of handling and transporting dangerous goods including labeling, packaging,

documentation and quantity limitations.

## **B. SYNOPSIS**

### **1. Section 1 - Applicability**

The first of eleven sections, section 1 defines dangerous goods and sets guidelines for airline acceptance of dangerous goods which apply throughout the regulation. Important subsections include 1.3 which delineates shipper's responsibilities. Shipper responsibility begins with compliance. Compliance involves the following two aspects:

- Shippers must comply fully with the IATA Dangerous Goods regulation as well as the regulations set forth by the countries of origin, transit or destination.
- Shippers found in violation of the IATA Dangerous Goods Regulation may be subject to legal penalties since the IATA complies fully with the International Civil Aviation Organization (ICAO) Technical Instructions. [Ref 2]

Subsection 1.3.2 lists specific responsibilities which include:

- The shipper must ensure the articles/substances are not prohibited for transport by air.
- The goods must be properly classified, packed, marked, labeled and documented as indicated in the IATA Dangerous Goods Regulation. [Ref 2]

Subsection 1.3.3, Special Arrangements, "requires the shipper of infectious substances must make advance arrangements with the carrier and the consignee prior to tender." [Ref 2] It also lists other instances when advanced notice is required before tendering substances. The first section concludes with training requirements guidelines for airline personnel and shippers' agents.

## 2. Section 2 - Limitations

In their training modules, Delta Airlines introduces section 2 as follows:

Limitations regarding the acceptability of dangerous goods are established in this section. Subsection 2.1 contains Table 2.1.A which provides an alphabetical list of dangerous goods which are forbidden in aircraft under any circumstances.  
[Ref 7]

Subsection 2.2 provides a list of problematic general cargo/baggage categories for cargo handling specialists to be wary of. These commodities have in the past contained hidden dangerous goods, and agents need to inspect these items to ensure they are safe for air shipment. Examples include "camping gear" which may contain flammable gas, flammable liquid, matches or other dangerous goods; "bull semen" which may involve the use of dry ice or refrigerated liquefied gas; and "pharmaceutical" which may contain dangerous chemicals either listed individually by name or covered by n.o.s. entries. Subsection 2.3 contains Table 2.3.A which lists certain dangerous goods which are permitted in passenger or crew baggage under certain circumstances. Examples include alcoholic beverages, batteries attached to wheelchairs or other mobility aids and smoking incendiary aids such as lighters and safety matches.

Subsections 2.7 and 2.8 spell out the provisions for dangerous goods in "excepted quantities" and dangerous goods in "limited quantities." Dangerous goods in excepted quantities are those which are transported in very small quantities in such a manner that excepts them from the marking, loading and documentary requirements of the IATA regulations.

Dangerous goods in limited quantities are those which require complete documentation and marking and are permitted

on passenger aircraft in designated quantities. They must meet the criteria of specific classes, divisions and packing groups. [Ref 7]

Subsection 2.9 provides state and operator variations to the Dangerous Goods regulations. State variations are actually foreign government modifications to the regulations which toughen requirements and are identified by a three-letter country code followed by two numbers. For example, the thirty-four variations of United States are depicted by USG-01 through USG-34. USG-19 is an important one. It states that:

No more than 25 kgs. net weight of dangerous goods will be permitted onboard a passenger aircraft in an inaccessible cargo compartment with the exception of non-flammable gas which has a maximum limitation of 75 kgs. per compartment. [Ref 2]

Operator or airline variations are identified by the two-letter airline code and two numbers. For example, Iran Air's more stringent requirement that all fuel tanks must be completely drained of fuels is depicted by IR-01. An individual airline may have no variations or as many as five or six.

### **3. Section 3 - Classification of Dangerous Goods**

This section describes and defines all nine hazard classes. As described in Chapter II of this thesis, some hazard classes are broken down into divisions because of the wide scope of the class. Later in the section packing groups are discussed. Explanations of packing groups is also found in Chapter II of this thesis.

### **4. Section 4 - Identification**

This section centers around the alphabetical list of dangerous goods located in subsection 4.2. The list is composed of the substances which are most frequently offered for air transportation. Articles and substances are listed either by their technical name or by an entry relating to a

generic group or hazard class. While the List of Dangerous Goods is updated regularly, there will be occasions when certain mixtures, new articles or substances are not shown in the list. This does not mean they are not hazardous just that additional classification is required. Table 6 shows the substance "strontium peroxide" as it appears in the list of dangerous goods.

UN or ID No.	Proper Shipping Name/Description	Class or Divi- sion	Subsi- diary Risk	Hazard Labels	Pkg Grp	PASSENGER AIRCRAFT		CARGO AIRCRAFT ONLY		Spec- ial Provi- sions see Sub- sect 4.4
						Pkg Inst	Max Net Qty Pkg	Pkg Inst	Max Net Qty Pkg	
A	B	C	D	E	F	G	H	I	J	K
1509	<b>Strontium peroxide</b>	5.1		Oxidiz Oxidiz	II II	508 Y508	5 k 2.5k	511	25kg	

Table 6. Alphabetical List of Dangerous Goods From Ref. [2]

The necessary packaging requirements for the dangerous good "strontium peroxide" are contained in eleven alphabetical columns, A through K. Column A is the UN or ID number assigned to the substance. This number (UN1509) provides universal identification in the United Nations classification system. Delta Airlines training guide explains columns A and B this way:

An ID number in the 8000 series would be used if a substance is not identified by IATA in the UN classification system. Column B lists the proper shipping name of the substance. The proper shipping name always appears in **boldface** print. Additional descriptive text to define the article more precisely is shown in light characters and is not part of the proper shipping name but may also appear on the package or Shipper's Declaration. [Ref 7]

Column C contains the primary hazard class and division (if applicable) of the substance (e.g., 5.1). Column D



describes the secondary or subsidiary risk (if applicable) of the substance. In this example there is none. Column E indicates the proper primary and secondary labels that must be used. In column F, the packing group assignment is designated for both labels. This assignment (e.g., II) is made based on the degree of danger a substance exhibits.

Columns G and H contain information for both labels regarding the packaging and quantity requirements for passenger aircraft. Column G refers to packing instructions (similar to the "packaging paragraphs" contained in the 49 CFR) found in section 5 of the IATA regulations. The maximum quantity per package information for passenger aircraft is indicated in column H. Columns I and J contain the same information for cargo only operations. Column K may refer the user to a list of special instructions located in subsection 4.4. [Refs 2, 7, 21]

#### **5. Section 5 - Packing**

Section 5 explains how dangerous goods must be packed by providing specific packaging requirements for each substance in the IATA regulations. There are three basic types of packaging used to ship dangerous goods, other than radioactive material:

- UN Specification Packagings;
- Limited Quantity Packagings;
- Non-Specification Packaging.

The packaging requirements are listed by a three digit packing instruction number. The first number will always be the same as the substance hazard class number. For instance, in the case of "strontium peroxide", there are two packing instruction numbers, 508 and Y508. The "5" in both packing instruction numbers designates the substance as assigned to Hazard Class 5. Included in each instruction number is a list

of state and operator variations which refer the user to subsection 2.9 for variation information.

The "UN Specification" package is one that has been approved by the United Nations' International Civil Aviation Organization after passing drop, stacking, design and performance tests. Packing instruction 508 is a "UN Specification" packing instruction.

"Limited Quantity" packaging is designated by the letter "Y". In the example "strontium peroxide," the "Limited Quantity" packing instruction is Y508. Limited Quantity packaging has not been approved by UN/ICAO, but is allowed provided the packaging conforms to combination packaging construction criteria. A combination package consists of one or more inner package contained in one outer package. For example, two metal cans (the inner packages), are contained in an outer package consisting of a fiberboard box. Additionally, the amount of the substance is severely limited when compared to specification type packaging.

Non Specification Packaging is packaging that has not been approved by the United Nations. Under Performance Oriented Packaging standards if the container passes the required tests it is acceptable for use. The burden of responsibility rests with the shipper in the event of mishap. [Refs 2, 7, 21]

#### **6. Section 6 - Radioactive Material**

The most complex of all of the hazard classes, radioactive material is covered in this section. Beginning with basic terminology definitions, this section covers units of measure, packing, handling and labeling instructions for radioactive materials. Radioactive materials are defined as articles or substances which spontaneously and continuously emit ionizing radiation which can be harmful to the health of humans and can affect photographic or x-ray film. The two primary risks from radioactive materials are:

- Contamination - which occurs when one comes in direct contact either externally or internally with the radioactive material;
- Radiation - which is being exposed to Alpha, Beta or Gamma radiation being emitted by the radioactive material.

"Packaging for radioactive material is designed and tested to prevent leakage (avoid contamination) and to reduce external radiation to safe levels." [Ref 21] Detailed requirements covering all types of radioactive material packaging are contained in this section. Due to the complexity of the material, it is omitted from this thesis.

#### **7. Section 7 - Marking and Labeling**

Information concerning the marking and labeling requirements for dangerous goods is included in this section. According to the IATA Dangerous Goods Training Program:

Markings and labels serve the following purposes:

- they indicate the contents of the package;
- they indicate that the packaging meets approved standards;
- they provide safe handling and stowage information;
- they indicate the nature of the hazard(s). [Ref 21]

The markings on each package of dangerous goods must be permanent and provide contrast so as to be readily visible. Marking not relevant to the dangerous goods package should be removed or obliterated. As mentioned above, all packages must be marked with the proper shipping name, UN or ID number and the name and address of shipper and consignee. Section seven concludes with full color illustrations of all the labels along with instructions for specification markings.

## 8. Section 8 - Documentation

There are two documents used in the shipment of dangerous goods, the Shipper's Declaration and the air waybill that accompanies the material. The proper preparation requirements for these two documents are covered in this section. Line by line, detailed instruction is provided. Paragraph 8.0.2 Shippers Responsibility reads:

The shipper is responsible for the completion of a prescribed declaration form, **Shipper's Declaration for Dangerous Goods**, for each and every shipment containing dangerous goods so defined or classified in these Regulations unless it is stated that a Shipper's Declaration is not required. [Ref 2]

Some of the key requirements of the IATA Dangerous Goods Regulations are that at least two copies of the Shipper's Declaration be completed and signed for presentation to the airline and that the Declaration must be written in English with supplemental foreign language translations added if deemed necessary. The IATA specifies that:

One copy is retained on file by the shipper while the second accompanies the material. A Shipper's Declaration form that has been altered or amended will not be accepted unless the alteration is signed by the original shipper. If a Shipper's Declaration is rejected by the airline, an entirely new form must be completed. [Ref 7]

The section concludes with color examples of Shipper's Declarations similar to figure 1 of this thesis.

## 9. Section 9 - Handling

Information concerning dangerous goods acceptance, handling, loading, storage and aircraft commander notification is contained in this section. This section applies to airline operations personnel (ramp) as well as cargo personnel. It points out that an operator may reject any materials tendered to him for any reason or he may impose stricter requirements

than are contained in the IATA. Section 9 mandates the use of checklists to ensure regulatory compliance. Table 9.3.A depicts package segregation requirements by hazard class and division. The safe securing of goods for flight, procedures to be followed in the event of damaged packages, and the movement of animals with dangerous goods are all delineated. The section concludes with instructions for completing the written notice of dangerous goods to the pilot-in-command or the Notification to Aircraft Commander (NOTAC). [Ref 7]

#### **10. Packing Specifications and Performance Tests**

United Nations packaging specifications and performance testing for all hazard classes except radioactive materials are covered in this section. Due to the complex nature of this class, the packing specifications and performance tests for radioactive materials are segregated in Section 6.

The IATA Dangerous Goods Regulation describes in detail the codes used to designate types of UN packaging. It states:

There are two systems of codes used by the IATA for designating packaging types. The first is applicable to packagings other than inner packagings. The second is applicable to inner packagings. For outer or single packagings a three-character code is used for designating the packaging. It is comprised of:

- an Arabic numeral indicating the type of packaging, e.g., drum, jerrican, etc;
- followed by a capital letter(s) indicating the nature of the material, e.g., steel, wood, etc.;
- followed, where necessary, by an Arabic numeral indicating the category of packaging within the type to which the packaging belongs.

For composite packagings, two capital letters are used to indicate the nature of the materials, the first indicates the material of the inner receptacle and the second indicates the material of the outer packaging. [Ref 2]

The following are Packaging Type Codes:

- 1 - Drum
- 2 - Wooden barrel
- 3 - Jerrican
- 4 - Box
- 5 - Bag
- 6 - Composite packaging
- 7 - Pressure receptacle

The following are Packaging Material Codes:

- A - Steel (all types and surface treatments)
- B - Aluminum
- C - Natural wood
- D - Plywood
- F - Reconstituted wood
- G - Fiberboard
- H - Plastic material
- L - Textile
- M - Paper, multi-wall
- N - Metal (other than steel or aluminum)
- P - Glass, porcelain or stoneware [Ref 2]

Additionally, the various markings of UN specification packagings required by shippers of dangerous goods are listed. The remainder of this section details the various types of tests the shipper of dangerous goods is required to perform before certifying that the packing used conforms to IATA regulations standards.

#### 11. Appendices

Appendix A provides a list of definitions of the commonly used terms found in the regulation. Where the terms possess the same meanings as would be found in a standard dictionary, they are not included.

The IATA Dangerous Goods Regulation introduces Appendix B this way:

This Appendix describes the Nomenclature used in these Regulations in three parts. Subsection B.1 describes the Units of Measurement. Subsection B.2 lists the Symbols, Abbreviations and Cargo IMP Codes. Subsection B.3 contains tables of useful conversion factors to and from SI (International System) units. [Ref 2]

Appendix C contains the list of currently assigned self-reactive substances of division 4.1. It also contains the list of currently assigned organic peroxides of division 5.2.

Airlines accepting dangerous goods for transportation in accordance with the terms and conditions found in the IATA Dangerous Goods Regulations are listed in Appendix D.

Starting with Algeria and ending with Zimbabwe, Appendix E lists the Competent Authorities who regulate hazardous materials transportation in the respective countries.

Appendix F lists the package testing facilities, package manufacturers and suppliers throughout the world. For example, in Zimbabwe there are no authorized facilities.

Appendix G is a bibliography of the sources used in compiling the regulation.

## **12. Dangerous Goods Training Programs**

In an effort to achieve a uniform level of worldwide training, the ICAO and IATA developed a series of four books designed to instruct specific categories of personnel involved in the transport of dangerous goods by air. The four books in the series are:

Book 1: Shippers; Cargo Agents; Operators' Cargo Acceptance Staff

Book 2: Load Planners and Flight Crew

Book 3: Passenger Handling Staff and Flight Attendants

Book 4: Loading and Warehouse Personnel

Book 1 was a valuable resource in writing this thesis chapter. By using an internationally developed training program, greater worldwide acceptance by national authorities was achieved.

Nearly identical in appearance to the IATA Dangerous Goods Regulation, the goal of this self study book is to familiarize the reader with the various sections of the IATA and demonstrate the correct application of principles. This is achieved through the use of:

- Extracts from the text of the Dangerous Goods Regulation.
- Guidance notes to help you interpret the Regulations.
- Examples in the application of the Regulations.
- Practical exercises to test your understanding of the Regulations with the answers provided in the back of the book. [Ref 21]

Clear, concise and well written just like the IATA Dangerous Goods Regulation, this training program is a valuable tool to obtain and maintain hazardous material transportation proficiency.





## **V. COMMERCIAL AIR CARRIER OPERATIONS**

### **A. BACKGROUND**

The Hazardous Materials Transportation Uniform Safety Act of 1990 (HMTUSA) has greatly affected commercial carrier hazardous materials operations. Congress, responding to increased public awareness and concern, amended the provisions of the Hazardous Materials Transportation Act of 1975 to provide stricter control over all aspects of hazardous material transportation. Among the provisions of HMTUSA is Docket HM-126F which mandates intensified and expanded training requirements. Referred to in the airline industry as the "train the janitor" law, HM-126F requires that any person directly or indirectly responsible for the safety of dangerous goods in the transportation system be trained, tested and certified. Training must include general awareness of and familiarization with hazardous materials, specific job function training, and safety training.

While most commercial air carriers vary in their dangerous goods handling policies, procedures and the work assignments their employees perform, four basic areas of responsibility can be identified. These areas are acceptance and processing, ground handling within the terminal and ramp areas, aircraft loading, and emergency procedures resulting from mishaps. You will note that these general areas mirror the four books in the IATA Dangerous Goods Regulation Training Program. [Refs 7, 8]

The remaining sections of this chapter describe the four main functional areas of hazardous materials handling as well as commercial training programs.

### **B. ACCEPTANCE AND PROCESSING**

The International Air Transport Association (IATA) Dangerous Goods Regulation is the predominant source of

guidance used in the processing of hazardous materials. Due to its applicability to domestic transport only, Title 49 Code of Federal Regulations is used to a much lesser degree with United Parcel Service (UPS) being one of the few major commercial carriers utilizing it. United Parcel Service does not transport international hazardous material by air, using subcontractors for the few countries (Germany and Japan predominantly) to which it ships. In fact, United Parcel Service would prefer not to handle hazardous materials at all, but does so only as a service to their customers. UPS accepts no poisons or radioactive materials and only class 1.4 explosives. A fee of \$10.00, equivalent to the fee charged by Federal Express, is added to the rate charged for hazardous material air packages in order to partially defray the additional cost involved with dangerous goods movement. [Ref 8]

Federal Express uses the acceptance and processing procedures found in the IATA. Shippers desiring to utilize Federal Express' dangerous goods services must adhere to country limitations and Federal Express' limitations found in chapter 2, page 36 of the IATA. For example, Class 1 articles and substances (explosives) will not be accepted for carriage outside the United States without prior approval. Even with permission, only certain explosives are transported and frequently the transport is strictly airport to airport. Division 6.1 (Poisons in Packing Groups I and II) and Division 7 (Radioactive Material) are not accepted for international transport. Hazardous waste is never accepted either domestically or internationally. [Refs 2, 11] The Defense Logistics Agency now uses Federal Express as its primary shipper of international dangerous goods. They also have begun using Federal Express for classified materials. Classified materials are sensitive military items such as confidential documents. With Federal Express, classified

materials now reach their overseas destinations before the Defense Transportation System can get the material to the aerial port of embarkation, and discussions are underway to make Federal Express the Department of Defense's primary classified material carrier. [Ref 22]

Delta Airlines handles a full range of hazard classes but accepts radioactive material only if a human medical necessity exists. [Ref 7]

As mentioned previously, the key to the safe processing, handling and transport of dangerous goods is sound training and strict adherence to methodical basic steps. While the procedures described below belong to Delta Airlines and Emery Worldwide and are followed by their personnel tasked with hazardous material handling, they can be applied throughout the industry. Adherence to procedures protects the safety of the aircraft and/or its occupants.

#### **1. Special Cargo Agent Duties**

The following steps must be strictly followed when accepting and processing dangerous goods.

- With IATA in hand, check subsection 2.1, Table 2.1.A to make sure the substance does not appear on the list of substances forbidden in aircraft under any circumstances.
- Locate the substance in the Alphabetical List of Dangerous Goods (subsection 4.2) and compare the Shipper's Declaration against the specifications listed in columns A through K.
- Verify the package type against the specifications printed in Section 5. Ensure the package is of good quality.
- Check all State and Operator variations for any carrier or country involved in the routing. This is found in Section 2.9. If the package is to be interlined, check the other carriers' variations as well.
- Check Section 7 to ensure the package complies with all

marking and labeling requirements.

- Make sure there are no physical (written) errors or omissions on the Shipper's Declaration. [Ref 7]

The special cargo agent must also be alert for hazardous substances, substances not listed in the IATA which may be hazardous, and dangerous goods in checked or carry-on baggage.

### **C. AIRPORT GROUND HANDLING**

This area requires the least detailed training with many of the procedures related to basic safety. United Parcel Service stresses the importance of surface to surface package handling. Material is lifted from one surface and placed on another. Packages should never be thrown or dropped. Gloves and safety shoes are worn for personal protection. Handlers need to visually inspect packages for damage and leakage, immediately "frustrating" any found unfit for further transport. Depending on the severity of the leakage and the material contained, emergency response procedures may be initiated. Attention must be paid to the "package orientation labels" which state "this side up" and to the "cargo only aircraft" labels. Ramp safety speed limits and other material handling equipment safety procedures must be followed to prevent damage to dangerous goods packages through handler negligence.

When material must be stored temporarily while awaiting aircraft loading, attention must be paid to segregation requirements particularly with regard to radioactive material. The IATA Dangerous Goods Regulation states:

Attention must be paid to self reactive substances of Division 4.1 or organic peroxides of Division 5.2 which must be shaded from direct sunlight and stored away from all sources of heat in a well ventilated area. Live animals should not be kept or loaded in close proximity to dry ice. [Ref 2]

#### D. AIRCRAFT LOADING

Regarding aircraft loading the IATA stipulates these rules:

Dangerous goods must not be carried in an aircraft cabin occupied by passengers or on the flight deck of an aircraft except items allowed by the IATA to be carried in baggage (cigarette lighters, colognes) and items belonging to the airline for use during the flight. [Ref 2]

All dangerous goods must be loaded in the cargo compartments. There are no restrictions on the overall quantities of dangerous goods to be shipped as long as the per package and per cargo compartment limitations are adhered to. As mentioned previously, one of the United States Government variations states that no more than 25 kgs. net weight of dangerous goods will be permitted onboard a passenger aircraft in an inaccessible cargo compartment. Dangerous goods segregation tables and loading charts help the aircraft load planners and cargo loading personnel keep incompatible materials separated.

Aircraft loaders must remain in frequent contact with the cargo acceptance clerks and the ground handling personnel. Good communication is a key factor in safe material transport. Packages should once again be inspected by the loaders to ensure there is no damage or leakage. The dangerous goods must be secured in the cargo compartments before flight departure. The securing frequently requires the use of load ballasts and/or the stacking of other packages around the dangerous goods to act as dunnage. If a unit load device such as an igloo is used, the exterior must display an identification tag indicating the hazard class(es) contained inside. Loaders must always be alert for loose or missing labels and reattach the labels as appropriate. Poisons should never be loaded with live animals or food. Dry ice should also

be kept away from live animals because the carbon dioxide gas given off displaces the oxygen in the compartment and may suffocate the animal. Dry ice parcels can also freeze other parcels that they may contact. Magnetized materials should be loaded as far aft as possible to avoid affecting navigation and other electronic equipment.

#### **E. EMERGENCY RESPONSE PROCEDURES**

The IATA Dangerous Goods Regulation requires emergency response training, but allows governments, airport authorities, airlines and others to devise their own response plans. United States Government variation USG-17 requires emergency response guidelines be maintained at the transportation facility. Many commercial airlines comply with this regulation by using the *Department of Transportation Emergency Response Guidebook* [Ref 35] at their facilities. According to the IATA Dangerous Goods Regulation Training Program, some basic emergency procedures to be followed by all employees who are involved in a hazardous material mishap include:

- Advise immediate supervisor right away.
- Isolate the package by removing objects around it.
- Avoid contact with the contents of the package.
- If contents come into contact with body or clothes:
  - thoroughly wash with plenty of water;
  - remove contaminated clothes;
  - do not eat or smoke;
  - keep hands away from eyes, mouth and nose;
  - try to get medical assistance.
- Stay at the scene of the incident until you can provide a full report of what transpired. [Ref 21]

Table 7 is taken from the IATA Dangerous Goods Training Program Book 1 and provides a guide to combating an emergency.

Hazard Class Division and Compatibility Group	Dangerous Goods Class	Hazard Description	Immediate Action Minimize leakage and contact with other cargo
1.3C 1.3G	Explosives (acceptable on Cargo Aircraft only)	Fire and minor blast hazard	<b>Notify Fire Brigade</b>
1.4B 1.4C 1.4D 1.4E 1.4G		Fire, but no other significant hazard	<b>Guard against fire</b>
1.4S	Explosives (safety)	Small fire hazard	<b>Guard against fire</b>
2.1 2.2 2.2	Flammable Gas Non-Flammable Gas Cryogenic Liquid	Ignites when leaking High press cyl burst Subcooling	See Explos Evacuate goods - ventilate area
2.3	Toxic Gas (acceptable on Cargo Aircraft Only)	High pressure cylinder bursting and toxic inhalation	<b>Keep away minimum 25 m</b>
3	Flammable Liquid	Ignites when leaking	See explosive
4.1 4.2 4.3	Flammable Solid Spont Combustible Dangerous when wet	Combustible, contributes to fire Ignites in contact with air Ignites in contact with water	Do not use water under any circum- stances

Table 7. Emergency Response Guide From Ref. [21]



Hazard Class Division and Compatibility Group	Dangerous Goods Class	Hazard Description	Immediate Action Minimize leakage and contact with other cargo
5.1 5.2	Oxidizer  Organic Peroxide	Ignites combustibles on contact Reacts violently with other substances	See explosive Do not use water
6.1  6.1 6.2	Poison  Harmful-Stow away from Foodstuffs Infectious Substance	Harmful if swallowed, inhaled or in contact with skin  Causes disease in Humans and animals	Isolate area Obtain qualified assist- ance Do not touch
7 Cat I 7 Cat II/III	Radioactive-White Radioactive- Yellow	Radiation hazards and harmful to health	<b>Keep away</b> minimum 25 m
8	Corrosive	Hazardous to skin and metal	See explosive Avoid contact with skin
9	Polymeric Beads  Magnetized Material Dry Ice  Miscellaneous Dangerous Goods	Evolves small quantities of flammable gas Affects navigation system Causes subcooling/ suffocation Hazards not covered by other classes	Avoid contact with skin No immediate action required

Table 7. Emergency Response Guide (continued)

Table 7 should be posted in all hazardous material handling areas. While it provides immediate on the scene guidance, additional more detailed information must be

obtained to mitigate the consequences of the incident or spill. Of course, different hazardous materials classes require different response procedures. For example, if a package of an infectious substance is damaged or leaking, the Centers for Disease Control in Atlanta, Georgia must be contacted immediately. Assistance and emergency directions for spilled radioactive material should come from the nearest Nuclear Regulatory Commission location.

Docket number HM-126C of the 1990 Hazardous Materials Transportation Uniform Safety Act (HMTUSA) addresses other response procedures. This act sought to improve emergency response procedures by legislating changes in hazardous material information communication. The law requires that carriers of all hazardous material shipments provide the 24-hour telephone number of a person who is knowledgeable about the hazardous product being shipped and who can provide specific information to emergency response teams arriving at the scene of an accident. A key to hazardous material identification is the use of the unique "UN" or "NA" number assigned to each hazardous material. Robert Moses in *Transportation of Hazardous Materials, Issues in Law, Social Science and Engineering* writes:

At a minimum the contact authority must provide a description of the material, its primary characteristics, immediate hazard to health, risk of fire or explosion, and immediate methods of handling the fire. This information can legally be provided in three different ways:

- on the shipping document;
- on the Material Safety Data Sheet (MSDS)
- in an Emergency Response Guidebook (ERG) and a shipping document that is cross referenced to it. [Ref 22]

The Emergency Response Teams within the United States are partially funded by another provision of HMTUSA which requires

all hazardous materials shippers to pay a registration fee to the Research and Special Projects Administration (RSPA) of the Department of Transportation. Shipper registration fees range from \$250 to \$5000 per company, depending on the amount and method of shipment. [Ref 6]

## **F. TRAINING**

According to the International Civil Aviation Organization and the International Air Transport Association:

Initial and recurrent Dangerous Goods training programs must be established and maintained by or on behalf of, regular shippers of dangerous goods and shipper's agents. [Ref 2]

The recurrent or "refresher" training must be within two years of the initial. Regulations 49 CFR/HM-181 states:

It is the duty of each person who offers hazardous materials for transportation to instruct each of its officers, agents and employees having any responsibility for preparing hazardous materials for shipment as to applicable regulations....  
[Ref 1]

Dangerous goods training in the commercial sector takes two forms. The first training effort focuses on employees of the transportation company. The second, equally important training area, involves training the shippers of hazardous materials. It is in the best interest of the transportation company to have trained customers who will not jeopardize the safety of the transportation company's personnel or assets.

### **1. In House Training**

Most large air transportation companies use a combination of proven training techniques. Among the most popular are computer based training, videos, independent programmed instruction using interactive workbooks, and on-the-job training. While Federal Express, United Parcel Service and

Emery Worldwide were willing to discuss their training programs in general terms, they would not release any materials for my review citing proprietary rights. In this fiercely competitive field, sources at these firms related experiences where training materials wound up in the possession of their business rivals. United Parcel Service routed my request through their legal department before turning me down. Only Delta Airlines sent me the training material I requested and it is for this reason that greater emphasis is given to their operations.

Delta Airlines uses all of the techniques mentioned above while stressing the programmed workbook approach. Their "All Pro Self-Study Modules" contain the following titles in the dangerous goods instruction series:

- Boarding Dangerous Goods
- Dangerous Goods Labels
- What are Dangerous Goods?
- Dangerous Goods in Baggage
- The IATA Dangerous Goods Regulation
- Dangerous Goods Acceptance and Handling
- Special Cargo Agent

To make the most effective use these training resources, they should be used in tandem with the IATA Dangerous Goods Regulation. Review questions, exercises and excerpts from the regulation make up the text with a comprehensive exam at the end of each module. Experienced personnel are available to assist and answer any questions that might arise.

## G. TRAINING THE CUSTOMER

Most large commercial carriers including Flying Tigers, Federal Express, Emery Worldwide and Delta Airlines offer dangerous goods training services to their major customers. The training sessions are sometimes designed specifically to meet an individual customer's needs. When this is the case, the sessions are held at the customer's facility. A more common alternate is the seminar approach which is held off site, such as at a hotel conference center, and involves all interested companies. Firms wishing to attend generally pay registration fees to the hosting air carrier. The three day course costs about \$400 per attendee and includes a copy of the IATA Dangerous Goods Regulation for each student. There are also private companies who specialize in hazardous material training. Among those advertizing in the IATA is the Dangerous Goods International Training Center of Woodside, California. Still other firms offer training software so that shippers can set up their own computer based training program.

According to Emery Worldwide advertizing literature "class activities are designed to clarify and simplify HAZMAT shipping." [Ref 17] The course of instruction includes videos, exercises and projects and concludes with a written exam which must be passed to obtain certification approval. Key knowledge and skills development is achieved by walking students through the IATA Dangerous Goods Regulation.

Transportation companies offering these training services do so for a number of reasons. First, it enhances customer good will. Second, it is a sales tool aimed at competing with other firms offering a similar service. Finally, and most important, it protects the personnel and assets of the commercial airline or transportation company. By increasing the likelihood that dangerous goods will be packaged properly, handled correctly and documented in accordance with applicable

laws, the transportation company reduces the risk of death, destruction and heavy fines.



**VI. JOINT PUBLICATION AFR 71-4:  
PREPARING HAZARDOUS MATERIALS FOR MILITARY AIR SHIPMENTS**

**A. BACKGROUND**

Joint publication Air Force Regulation 71-4 which also bears the distinctive numbering of the other services (TM 38-250, NAVSUP PUB 505, MCO P4030.19E, DLAM 4145.3) is used by the Departments of the Air Force, Army, Navy and Defense Logistics Agency to prepare hazardous materials for transportation. This regulation provides instructions for preparing hazardous material for transportation aboard military aircraft both fixed wing and rotary wing. Last revised in January 1988, the regulation applies to active duty forces as well as Reserve and National Guard units and is similar to Title 49 Code of Federal Regulations and the IATA Dangerous Goods Regulation in format and content. Frequently referred to simply as the AFR 71-4, this publication provides packing, marking, labeling and document preparation guidance to ensure safe material transport within the Department of Defense air transportation system.

**B. SYNOPSIS**

**1. Chapter 1 - Rules and Regulations**

The regulation begins with **General Procedures** which includes a definition of hazardous materials and then proceeds to identify the cognizant commands responsible for maintaining the regulation. Considered a "packaging" vice "transportation regulation", Headquarters Air Force Logistics Command (AFLC) and Headquarters United States Air Force (USAF) are the lead Department of Defense components responsible for the regulation. AFR 71-4 then lists the other service focal points which contribute to the composition of the publication. The Navy's point of contact is the Naval Supply Systems Command located in Washington DC.



Relying heavily on Title 49 Code of Federal Regulations sections 100-199 and the IATA Dangerous Goods Regulation, these publications can be used as packaging authority in lieu of AFR 71-4 as long as they comply with the **General Packaging Requirements** described in paragraph 1-2. This is a good thing because changes initiated by the Hazardous Material Uniform Safety Act of 1990 (HMUSA) have rendered much of the AFR 71-4 obsolete particularly in the area of "performance oriented packaging."

AFR 71-4 requires the use of the DD Form 1387-2, Special Handling Data/Certification, which is unique to the Department of Defense and repeats information found on the Shipper's Declaration. In addition to its use in identifying hazardous material, this form is also used for signature service cargo such as national security classified material. Procedures for completing this form as well as military specific passenger and cargo issues are found in this regulation. Also contained in the **General Procedures** section are directions for obtaining permission to utilize newly designed packaging.

Chapter 1 discusses inspection and quality control procedures to be followed by originating and in-transit shipment points. If during inspection problems are discovered, completion of one of two forms is required. The Transportation Discrepancy Report (SF 361) is used for discrepancies suspected to be transportation related. Within 72 hours of discovering a discrepancy, copies of the report should be sent to consignor, consignee, and any transshipment points. A second form, the Report of Discrepancy (SF 364), is used if the problem can be traced directly back to the shipper. A description of the discrepancy and recommended corrective action is sent to the shipper who in turn has 72 hours to respond.

If cargo is found to contain mistakes in packaging, documentation or if the package is damaged, the material must

be "frustrated" until corrective action is completed. If the discrepancy results in the release of a hazardous substance in a quantity equal to or greater than its "reportable quantity" the Coast Guard National Response Center must be notified at once.

Next the areas of alternative packaging (allowed as long as it meets or exceeds the packaging it replaces), "empty" packages, stowage and handling, protective equipment for military aircrews, and corrosive spills are briefly introduced. Rules pertaining to unitized, palletized and containerized loads are delineated in **section 1-10**. All hazardous material must be positioned on the pallet so that it is readily accessible in the event of an in flight emergency. Because of the lack of accessibility, hazardous materials shipped by military aircraft are not permitted to be stored in CONEX boxes. The only exception applies to CONEX boxes used by Underwater Construction Teams (UCT). **Section 1-11** discusses deviation waiver procedures required to move certain hazardous materials with passengers. The major command (MAJCOM) or service having operational control over the aircraft must authorize the deviation.

The chapter concludes with a discussion of training, penalties and disciplinary action. Extensive coverage is given to the qualification criteria for DOD certifying officials. Certification carries the authorization to sign the DD Form 1387-2 attesting to the acceptability of a hazardous materials package for air transportation. Personnel whose primary duty is preparing, certifying or inspecting hazardous materials shipments on a day-to-day basis are required to have completed either an initial or refresher training course within the past 24 calendar months. Taught at over a dozen locations or exportable to the command, these courses use mostly written exercises and focus primarily on DD 1387-2 document preparation. The length of the initial course

is two weeks while the refresher is of one week duration.

## **2. Chapter 2 - Special Requirements, Deviations and Waivers**

This short chapter comprising only four pages begins with aircraft commander notification procedures. It delineates eight specific bits of information per hazardous material that must be pointed out to the aircraft commander as well as providing a mandatory "air terminal inspection certification" statement which must be inscribed on the cargo manifest. A representative of the aircrew signs his own certification indicating the he has been briefed regarding the hazardous material loaded on his airplane.

Next in section 2-2, deviation policy is promulgated. "Deviations are departures from established policy." [Ref 9] Deviations are authorized for a specific mission or operation and must be approved by HQ USAF or the major command in charge of the operation. There are four conditions which normally precipitate deviation approval. They are:

- Recovery of downed aircraft.
- Emergency rescue operations.
- Movement of portable generators to support critical and key functions where power has been disrupted.
- Movement of fueled support equipment (SE) to replace inoperative equipment supporting an ongoing mobility exercise or operational plan. [Ref 9]

**Section 2-3 addresses packaging and compatibility waivers** and provides service component points of contact for granting such waivers. The regulation states that:

When Air Force aircraft are involved, compatibility waivers must pass through the service focal point to HQ USAF/LETT providing the following information in the waiver request:

- Reason the shipment must be made.

- Reason other modes of transportation can not be used.
- Statement that items have been packed so that if one item detonates or leaks, incompatible items in the same container or on the same aircraft are not subject to a propagation detonation, fire, or to contamination in conditions other than an aircraft crash.

The movement of incompatible items by Air Mobility Command contracted aircraft is forbidden, unless authorized by DOT exemption. [Ref 9]

Paragraph 2-4 discusses the procedures to be followed by the various services to request a Special Assignment Airlift Mission (SAAM). The chapter concludes with an examination of the unique requirements associated with poisons, radioactive materials, etiological agents, and biological research material.

### 3. Chapter 3 - Tactical or Contingency Airlift of Hazardous Materials

This is the publication's "go to war" or "respond to an emergency" chapter. Distinct from both Title 49 CFR and the IATA Dangerous Goods Regulation, this chapter is the primary reason the 71-4 exists. Recent recommendations by the Defense Logistics Agency (DLA) and some Air Force components including Headquarters Space Command and Headquarters Pacific Air Force to eliminate the AFR 71-4 and utilize the IATA were overruled because of the uniqueness of this chapter's provisions. [Refs 10, 24] If AFR 71-4 were to be eliminated, a separate military document would still be required to meet military needs and provide the special guidance now contained in Chapter 3 regulations.

A key element of this chapter is Table 3-1 (Load Configurations Cargo Items). This table lists normally noncompatible items which during contingency operations may be combined in order to ensure maximum use of military aircraft. The major command having operational control of the deploying

unit will indicate the combination of items being moved, for example "Table 3-1, items 1, 3, 9, 10, and 12 only" in the airlift request. Table 8 reproduces AFR 71-4 table 3-1.

Item	Description
1	Participating personnel with individual arms, small arms ammunition, individual protective equipment, and individual NBC equipment.
2	Grenades (hand, rifle, smoke, or tear gas).
3	Explosive mines.
4	Gasoline in 5-gallon cans or 55-gallon drums.
5	Fuel JP-4 or gasoline in containers meeting Mil Spec MIL-A-8421.
6	Motor vehicle, etc. with fuel in tank.
7	Ammunition for cannon with projectiles.
8	Rocket ammunition or missile with projectiles.
9	High explosives for demolition with separate detonating components.
10	Special and common fireworks and hand signal devices.
11	Aircraft and helicopters with JP-4 fuel or aviation gasoline in their tanks and small arms ammunition.
12	Small arms ammunition (bulk).
13	Riot control agents (bulk).
14	Individually wrapped trioxane or hexamine tablets in bulk.

Table 8. Load and Configuration Cargo Items From Ref. [9]

Authority is granted in this chapter to deviate from the "cargo only aircraft" restrictions and move troops with otherwise forbidden hazardous materials. The chapter also allows hazardous materials to be loaded in the same compartments as passengers.

The chapter concludes by delineating how contingency operations affect DD Form 1387-2 preparation, labeling and material inspection procedures.

#### 4. Chapter 4 - Items Listing

This chapter, comprising nearly half of the publication, is predominately Table 4-1 which provides an alphabetical listing by proper shipping name of all hazardous materials discussed in the remainder of the book. Encompassing six columns, this table is an abbreviated version of the hazardous materials tables found in Title 49 CFR and the IATA Dangerous Goods Regulation. Column headings are reproduced as Table 9. The only column unique to the AFR 71-4 is the "Load and Storage Group" (L/S) column. Load and storage groups define hazardous material compatibility as determined by the Department of Defense. This column contains a number between 1 and 29. An explanation of these numbers is found in Attachment 1 to the AFR 71-4. Attachment 1 also contains a chart which depicts which load and storage groups can be positioned together and which need to be separated.

Hazardous materials descriptions and proper shipping names	Hazard class	Identification number	Label(s) required (if not excepted)	Packaging Paragraph	L/S Group
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Table 9. Alphabetical Hazardous Items Listing After Ref. [9]

#### 5. Chapter 5 - Explosives and Ammunition

The first of eight packaging chapters, this section begins with some basic handling and packaging procedures and then defines terms beginning with the obsolete explosives categories, A, B, and C. Within each of these classes (no longer used in the civilian sector and thus eliminated from the IATA Dangerous Goods Regulation) additional definitions are provided for items such as detonating fuses, blasting caps and special fireworks. Definitions for the new Hazard Class/Division structure (i.e., 1.1, 1.2, etc.) follow.

Explosive safety is touched on briefly in **paragraph 5-3** with reference made to the precautions, standards and rules prescribed in the various Department of Defense component services' publications.

The chapter concludes with the packaging paragraphs which provide a detailed description of proper packaging for all explosive materials. Similar in format and style to the Title 49 CFR and the IATA, most packaging paragraphs provide both the DOT specifications (e.g., DOT 23F) and a verbal description so that suitable packaging can be fabricated in the field.

## **6. Chapter 6 - Flammable Liquids**

Chapter 6 starts with definitions and common sense handling instructions such as storing flammable liquids in cool, well ventilated areas and away from heat, combustible materials and oxidizing agents. The packaging paragraphs follow starting with **paragraph 6-6 Flammable Liquid, Not Specifically Provided For**.

An important packaging paragraph is **6-27 Fueled, Motor Vehicles, Engine Powered Support Equipment, and Motor Internal Combustion**. This paragraph states that Ground Support Equipment (GSE) may be shipped in a fueled condition during chapter 3 (contingency) operations only. This presents great difficulty for remote field operations which do not have draining capabilities. For example, Mobile Air Transportation Teams (MATT), set up to support the fleet at small airheads around the world (usually during military exercises), need to bring their own material handling equipment to load and unload aircraft. Without the ability to drain fuel from the material handling equipment, it is impossible for these remote airheads to arrange transportation of the MHE via aircraft. Even some major overseas United States air terminals such as Naples, Italy and Rota, Spain do not have the capability to completely drain a fork truck. Adherence to this packaging paragraph has

consistently caused delays and inconvenience for air crews and air terminal personnel. The equipment eventually is either operated until it runs out of fuel, transported via truck, or a Navy organic aircraft "pretends" that it has been drained and moves it to the destination. Once at the remote site, a search for fuel must be accomplished. A great inconsistency here is that helicopters, aircraft and motor vehicles routinely can be transported with half full gas tanks. This problem area is remedied in the Air Force Joint Manual 24-204 which replaces the AFR 71-4.

#### **7. Chapter 7 - Flammable Solids and Oxidizing Materials**

This chapter combines hazard classes 4 and 5 and begins with general information and definitions. Information in this section is outdated having been superseded by revisions to the 49 CFR and the IATA. The classes of "Substances Liable to Spontaneous Combustion," "Dangerous when Wet" and "Organic Peroxides" have been added by subsequent changes to regulations.

Following the introduction, the chapter discusses handling instructions which are similar to flammable liquids in the requirement to store in cool, well ventilated area. Additionally, it directs the materials to be stored away from moisture, corrosives and always tightly and securely closed. Eighteen pages of packaging paragraphs wrap up the chapter.

#### **8. Chapter 8 - Corrosive Materials**

Chapter 8 describes the potential for harm that mishandled corrosive materials can cause and provides handling and packaging guidance. In addition to the visible destruction to human skin tissue and materials such as steel or aluminum, corrosive liquids pose other hazards such as toxicity, flammability, and explosiveness. For this reason bottles of corrosives should not be packed in the same outside container with other hazardous materials unless specifically



authorized. Containers of corrosives should never be entirely filled in order to allow for expansion of contents during transit. There should always be enough absorbent material in the outer packaging to soak up the entire contents of the package. Specific "packaging paragraphs" encompass the bulk of the chapter.

#### **9. Chapter 9 - Compressed Gases**

Compressed gases, including those liquefied and those dissolved in solution, are most commonly shipped in cylinders or spherical pressure vessels. Compressed gases found in aerosol cans are considered limited quantities and are generally exempt from most packaging regulations. Because of the great pressure exerted on the containers holding compressed gases, the valves must be protected. AFR 71-4 lists four authorized ways to protect the valve from damage in the event a charged cylinder is dropped four feet onto a solid flat concrete floor. This cylinder drop is an example of a performance oriented packaging test.

Chapter 9 discusses the periodic inspection and retesting required by the 49 CFR. A listing of those DOT specification cylinders that must be shipped in a strong outside container is provided. Figures depicting cylinder service pressures, wall stress limitations and filling requirements follow. Handling instructions and discussion of compressed gases in small quantities precede the packaging paragraphs. The packaging requirements are depicted differently in this chapter with tables showing the maximum permitted filling densities in percentages for each listed gas.

#### **10. Chapter 10 - Poisonous Materials and Etiologic Agents**

Similar to the explosives chapter, this chapter contains outdated material. Reference is made to class A and B poisons and irritating materials. None of these terms are currently used. The term etiologic agent has been replaced by

infectious substance. Handling instructions and container regulations are stated and once again there is a requirement not to fill containers completely and to provide enough cushioning material to absorb the entire contents in the event of breakage. Seventeen pages of packaging paragraphs conclude the chapter.

#### **11. Chapter 11 - Other Regulated Materials**

Now part of Class 9, Miscellaneous Hazardous Materials, all but one category of Other Regulated Materials have been eliminated. Information in this chapter requires major revision. Only ORM-D remains as a viable description of hazardous material. ORM-D material is most often consumer commodities which pose a limited risk during transportation. This classification is no longer valid for international transportation and can be used domestically only. Like the other chapters, chapter 11 concludes with packaging paragraphs.

#### **12. Chapter 12 - Radioactive Materials**

Similar in design and format to the previous chapters, chapter 12 includes definitions and package design requirements, and addresses limited quantities. Paragraph 12.13 lists exceptions for instruments and articles (clocks, electronic tubes) which contain small amounts of radioactive material. Contamination control, storage incident to transportation, cargo/passenger separation requirements for passenger carrying aircraft, and cargo only aircraft procedures are described in this chapter.

#### **13. Chapter 13 - Marking, Labeling, Certifying, and Placarding Hazardous Materials**

There is little substantial difference between the marking and labeling procedures described in AFR 71-4 paragraphs 13-1 and 13-2 and those described in 49 CFR and the IATA Dangerous Goods Regulation.

Paragraph 13-3, Shipper's Certification, is probably the

key focal point of Department of Defense hazardous material transportation operations. A DD Form 1387-2, Special Handling Data/Certification, must be attached to all Department of Defense hazardous material shipments and must be included with the shipping manifest. Referred to as the "Dash 2", small errors such as in punctuation or letters typed on the red border line of this document can immediately frustrate a hazardous material package traveling in the Air Mobility Command system. For this reason the bulk of Department of Defense hazardous material training centers on the accurate completion of this form. Four pages of correctly filled out 1387-2's are provided as examples and completion instructions for each of the twenty blocks are provided.

The chapter concludes with a section on area placarding. While the aircraft itself is not placarded, a boundary area around the aircraft is. This is required even when DOD owned or controlled aircraft are parked in a restricted, posted and traffic controlled area. The placards must be conspicuously displayed at the front, rear, and both sides of the aircraft when explosives, poisons or radioactive materials are onboard. Quantity limits must be exceeded before area placarding is required for other hazard classes.

#### **14. Attachments**

Attachment 1, Load and Storage Groups, is a three page attachment which includes the "Loading and Storage" chart referenced in table 4.1, the Alphabetical Listing of Hazardous Materials. A letter "X" at the intersection of horizontal and vertically numbered columns denotes articles that must not be loaded or stored together. Explanations of the 29 different load and storage groups used by the DOD as well as additional comments are also found here.

Attachment 2, Container Specifications, is now obsolete. Before the onset of the United Nations directed "performance oriented packaging" this was a valuable reference tool.

Section A provided a numeric-alpha cross reference listing of DOT specification to Federal/Military specifications. Beginning with DOT specification "1A", boxed carboys and ending with "45B", lined bags, cloth and paper, this listing provides a verbal description of all DOT packages and also lists the applicable packaging paragraphs contained in 49 CFR. Section B provides similar information cross referencing the Federal and military specifications to DOT specifications.

Attachment 3 contains the Table of Flash Points. The DD Form 1387-2 requires that flash point data be entered in block 10 for all flammable liquids. Pertinent data in both fahrenheit and celsius for alphabetically listed substances is found here.

Attachment 4, Neutralization of Corrosive Materials, contains an eight page table which alphabetically lists corrosive materials, their neutralizing agents, the percentage mixture to be used, and one of eight neutralizing methods to be employed. Certain corrosive materials are preceded by an asterisk and require only water as a neutralizing agent.

Attachment 5, Table of Equivalent Measures, is the final attachment and contains one page of tables converting volume, weight, length, temperature and net gas quantities to metric format.



**VII. AIR FORCE JOINT MANUAL 24-204:  
PREPARING HAZARDOUS MATERIALS FOR MILITARY AIR SHIPMENTS**

**A. BACKGROUND**

**1. Was Joint Manual 24-204 Necessary?**

The new Air Force Joint Manual 24-204 which revises and replaces the AFR 71-4 almost never came to fruition. Nearly seven years from inception to completion, its necessity was frequently debated. Duane Pfund, one of the co-authors of the revised manual, told me that the idea to eliminate the regulation went back and forth six or seven times before a final decision was made. [Ref 16] As late as January 1992, major commands within the Air Force as well as the Defense Logistics Agency still challenged the Air Force Logistics Command to justify why the International Air Transport Associations' Dangerous Goods Regulation should not be the source document for hazardous material preparation and transportation.

The opinion that this publication was redundant and superfluous was fostered by the fact that the AFR 71-4, last updated in January 1988 had become obsolete. Truman Taylor, a Safety Specialist at the US Army Safety Center and the Army's key person for the AFR 71-4 rewrite, commented that Army field activities could not even get copies of the manual because orders for obsolete manuals are routinely rejected by the publication distribution centers. Many Army units used the IATA or went without guidance. [Ref 14] Bob Jaffin, Hazardous Material Transportation Instructor at the Naval Supply Corps School, described AFR 71-4 as "a worthless instruction for the past four years." [Ref 12] As a result of the 1990 United Nations recommendations, changes to hazardous material transportation regulations were implemented worldwide. In the United States, The Hazardous Material Transportation Uniform Safety Act of 1990 (HMTUSA) rendered

portions of the AFR 71-4 unusable.

Depending on the commodity being shipped, Department of Defense activities were frequently required to use a combination of the three reference publications: AFR 71-4, IATA Dangerous Goods Regulation and Title 49 Code of Federal Regulations. The IATA provided hazard classification and packaging information for general hazardous material in small, commercial quantities. IATA provides no packaging information for explosive classes 1.1 - 1.3, class 2 compressed gases, and only small amounts of packaging data for classes 5, 6 and 7. Title 49 CFR was needed to provide the information not covered by the IATA.

Many Defense Logistics Agency facilities were able to stop using the AFR 71-4 entirely and rely exclusively on the easy to use, annually updated IATA to fulfill routine hazardous material requisitions. The AFR 71-4 was still required for military unique operational requirements and as a certification reference if the requirements of the IATA could not be met. [Ref 16]

At the Hazardous Material Packaging and Transportation conference held at Headquarters Air Force Logistics Command (now the Air Force Material Command as a result of consolidation with the Air Force Systems Command), Wright-Patterson Air Force Base, Ohio on 28-30 January 1992, Air Mobility Command's Del Hamilton finally put to rest the AFR 71-4 necessity debate.

Del Hamilton stated that the "Air Force Joint Manual 24-204 would conform, as much as possible, with international standards while still supporting military unique requirements." [Ref 24] It would be pertinent and acceptable for use in international transportation. He pointed out that the IATA Dangerous Goods Regulation strictly limits hazardous material quantities and provided the following examples:

- Diesel Fuel: 1.25 gallons (passenger aircraft) or 13 gallons (cargo aircraft only) per container.
- Flares (C/D 1.4G): Forbidden in passenger aircraft and no more than 165 pounds net weight on cargo aircraft.
- Flammable liquids N.O.S.: Depending on flashpoint, quantities could be limited to 1 quart (passenger aircraft) or 7.5 gallons (cargo aircraft only) per container. [Ref 24]

The Department of Defense, the biggest volume transporter of hazardous materials in the world, moves pallets of flares and 55 gallon drums of hazardous liquids. These large quantities obviously violate the provisions of the IATA.

Additionally, contingency and wartime operations are not addressed by commercial regulations. Separate regulation(s) addressing Chapter 3 operations, as well as military unique policies, would still have to be disseminated to the field. Even if the IATA was used for certification purposes, field activities would still need at least one other publication.

## **2. Drafting the New Air Force Joint Manual**

In order to understand the metamorphosis of *Preparing Hazardous Materials for Military Air Shipments* from an obsolete regulation shunned by the user to a viable manual capable of servicing Department of Defense needs, it must be remembered that the publication is a "packaging" document not a "transportation" document. As such, management responsibility for preparing and maintaining the publication was vested in the Air Force Material Command.

This command, with four GS-12 Packaging Specialists and package test facilities limited to self-made packages, was tasked with working with all the other services and agencies to ensure a quality end product. Service/Agency focal points were responsible for reviewing draft copies of the manual, attending manual development conferences, answering questions, distributing information and providing guidance to their



respective activities regarding air transportation of hazardous materials. [Ref 10]

The Air Force Material Command received considerable preparation assistance from the Air Mobility Command, but little input from other activities. The United States Transportation Command (USTRANSCOM), which has been assuming cognizance over a growing number of Department of Defense transportation regulations, most recently DTMR 75-1, made no major contribution. [Ref 19] Because Joint Manual 24-204 was based closely on the highly regarded IATA Dangerous Goods Regulation, most of the content was readily accepted by the various services. Except to voice objection to new recertification training procedures, the Marine Corps, Navy and the Defense Logistics Agency without hesitation accepted much of the revised work. [Refs 24, 25, 26] The Navy Supply Systems Command Transportation Division, in particular, showed little interest in the manual's development. The Army made a substantial contribution to the development of chapter 3, "Tactical, Contingency, or Emergency Airlift", and joined the Navy in objecting to the newly proposed recertification training procedures. [Ref 14]

Interestingly, the final product was labeled a "transportation" manual and the Office of Primary Responsibility may shift to the Air Mobility Command in the next few years.

## **B. SYNOPSIS**

### **1. Content and Format**

Initially due for publication in December 1992, many factors affected the evolution and subsequent release of Joint Manual 24-204. Among these factors were mandated changes in Air Force writing style and manual formats, debates as to whether the publication should be a regulation or a manual, battles with the Air Force Publishing Center at Bolling Air

Force Base in Washington D.C. to obtain local editing authority, and efforts to comply with Vice President Gore's paperwork reduction campaign. The final manual contains only three chapters vice AFR 71-4's thirteen; thus full credit was granted for paperwork reduction. The fact that Joint Manual 24-204 contains 29 attachments and is actually 47 pages longer than the one it replaced is inconsequential.

The changes to Joint Manual 24-204 are both cosmetic and substantive. No longer a regulation, this revised manual not only incorporates all applicable changes to domestic and international hazardous material laws, it does so in a clear, concise, easy to use format. AFJMAN 24-204 provides a single source document for military air hazardous material shipments. Available now in CD-ROM as well as printed form, the user has only three chapters totalling thirteen pages of text to read. The remainder of the publication is composed of 29 attachments where the user can quickly find the necessary information.

Among the most significant changes implemented by this revision are the conversion of DOT, Federal and Military specification packaging to Performance Oriented Packaging (POP) and the adoption of the same Shipper's Declaration for Dangerous Goods form used by the commercial sector to document hazardous materials. The elimination of the military unique DD 1387-2 is a major step toward improved efficiency and enhanced interoperability with the commercial sector.

## **2. Changes in Chapters**

Among the changes found in chapter 1 is a lengthy discussion of Performance Oriented Packaging (POP) which includes a governmental grandfather clause. Government-owned goods packaged before January 1, 1990 are exempt from POP requirements. There is also a paragraph directing contracting officers to ensure that purchase requests for hazardous materials include provisions of the supplement to the Federal Acquisition Regulation (FAR) regarding Performance Oriented

Packaging compliance. A portion of this chapter is now dedicated to basic hazardous material certification instructions.

The concept of limited quantities, which first appeared in the 1991 edition of the IATA Dangerous Goods Regulation is introduced in chapter 2. This provision which allows packages in small quantities to be shipped without UN testing and certification is now authorized for Department of Defense owned or controlled aircraft.

In the wake of Dessert Shield/Dessert Storm, procedures for protecting cargo from chemical contamination were added to the chapter 3, contingency section of the manual. Provisions for mitigating the effects of chemical exposure to cargo and equipment are also covered. The compatibility table, now found in attachment 18, has been expanded to accommodate more risk during tactical exercises and wartime operations. Greater quantities of fuel are now permitted in vehicles transported to the site of military exercises.

The Alphabetical Listings of Items Table has been revised to include UN proper shipping names and expanded instructions on use. Now attachment 4 vice chapter 4, it is printed in a landscape format for easier reading.

### **3. The 29 Attachments**

#### ***a. Attachment 1 - Terms Explained***

Definitions that began the chapters of the 71-4 are consolidated in this attachment.

#### ***b. Attachment 2 - Abbreviations and Acronyms***

This is a newly added convenient reference aid.

#### ***c. Attachment 3 - General and Hazardous Class Specific Packaging Requirements***

The general requirements of attachment 3 are in addition to the specific packaging requirements outlined in attachments 5 through 13. For example, unless specifically authorized, the maximum capacity of metal drums is 208 liters

or the more familiar 55 gallons.

*d. Attachment 4 - Items Listing*

This section contains an alphabetical listing of all hazardous materials offered for air transportation. It also includes those that are prohibited.

*e. Attachments 5 - 13 Hazard Classes*

Attachments 5 - 13 contain the information previously found in corresponding chapters of the AFR 71-4. The new United Nations requirements have been incorporated. Of particular note is the deletion of the requirement to drain and purge ground support equipment and the inclusion of lithium battery handling requirements. [Ref 10]

*f. Attachment 14 - Marking Hazardous Materials*

This attachment incorporates new United Nations marking requirements. Figure A14.1 depicts the symbols and codes used to certify that a package complies with Performance Oriented Packaging (POP).

*g. Attachments 15 - 16 - Labeling and Placarding*

This section updates the AFR 71-4 material for labeling and placarding.

*h. Attachment 17 - Certifying Hazardous Materials*

Certification instructions are now provided separately in this attachment. The DD Form 1387-2 has been replaced by the Shipper's Declaration for Dangerous Goods. While copies of the certification may be placed in a waterproof envelope and attached to the number one piece of a shipment, the requirement to attach a copy to each shipping container no longer applies. Figure A17.4 provides examples of properly completed Shipper's Declaration for Dangerous Goods forms. The certification form can now be handwritten which is a great aid to troops operating in the field. Pen and ink changes to any block on the form are now authorized as long as the change is signed by the certifying official.

*i. Attachment 18 - Compatibility*

The Department of Defense has adopted the IATA Dangerous Goods Regulation compatibility tables based on hazard class numbers. Transportation and storage compatibility requirements are now aligned. The use of load and storage group numbers has been eliminated. Hazard class 1 materials (Explosives) now have their own compatibility table in addition to inclusion on the master table A18.1.

*j. Attachment 19 - Excepted and Limited Quantities*

Introduced in chapter 2, this change is expounded upon. Table A19.1 "Quantity Limits for Inner and Outer Packaging" and Table A19.2 which refers to "Different Dangerous Goods in Limited Quantities in one Package" provides maximum quantities for hazard classes 2-9 based on packing group and physical state.

*k. Attachment 20 - Absorbent Cushioning Requirements*

Hazardous liquids in packaging groups I and II require absorbent cushioning material. Suitable materials are diatomaceous earth or untreated vermiculite. Table A20.1 "Absorbent Material Requirements in Inches" provides the data on quantity and placement.

*l. Attachments 21 through 28 - Various Subjects*

These attachments are similar to information found in the old AFR 71-4.

**C. TRAINING**

This was a major stumbling block in gaining final draft approval of the manual by the service components. Headquarters Air Force, in an effort to reduce training expenses, particularly travel and per diem, has adopted a decentralized approach to conducting training. Each Air Force base now has an education center where many courses are taught. In fact, according to Bill Bass, Director of Training

at the Air Education and Training Command, Lackland Air Force Base, the goal is to eventually teach 100% of courses locally. The belief is that at each base education center, there will be knowledgeable people who can assist students and answer questions. [Ref 15]

Unbeknownst to the Air Force Material Command, Navy, Army, Marines and the Defense Logistics Agency, "Hazardous Material Certification Refresher Training" was one such course earmarked for local training. The proposal not only allowed people to train themselves, but allowed them to recertify themselves as well. When the final draft version was sent to Washington for pre-publication editing, the training section was modified to provide for localized training.

When the completed manual was routed back to the services for approval they all balked. They deemed hazardous material certification too dangerous a subject to allow sailors, soldiers and marines to teach themselves and then pronounce themselves qualified. They feared a loss of standardization and process control. The services also questioned the notion that knowledgeable people would always be available to assist and supervise, especially at sea, in the field, or in remote locations. They insisted that the course be taught as before at the service schools or on an exportable basis to their commands. Headquarters Air Force backed down and training remains as it was in ARF 71-4. [Refs 14, 27, 29]

With a March 1, 1995 implementation date, a clear training plan for certifying and recertifying Department of Defense hazardous material shipping personnel in the use of the new manual is not yet in place. Introducing Air Force Manual 24-204 to the myriad of people who will depend on it is no easy task, but little planning has been done in this area. The Air Force's 37th Training Group, Air Education and Training Center at Lackland Air Force Base has yet to revise

their training program. When contacted during the first week in January 1995, representatives of the command commented that the new manual was much like the old regulation and that little modification to the initial and refresher courses would be required. [Ref 15] Bob Jaffin, the hazardous materials transportation instructor at the Navy Supply Corps School, said he had received no guidance regarding changes to the curriculum and as of January 5, 1995 had yet to receive his copy of AFM 24-204. [Ref 12]

According to new joint doctrine, whenever possible, the services are to coordinate training in order to provide greater consistency, efficiency, and cost savings. Since it took seven years to complete the revision, it seems unusual that a training program was not devised for the service schools simultaneously.

This is not to say that no training has been accomplished. In November 1994, the Air Force Material Command conducted a familiarization workshop at the Air Education and Training Command, 37th Training Group, Lackland Air Force Base, Florida for Air Force instructors covering the changes incorporated into the new manual. A separate training session was also held in November 1994 in Norfolk for Navy and Marine Corps personnel. The Air Mobility Command embarked on a worldwide campaign to educate people at all their aerial ports. In order to protect their personnel and assets, Del Hamilton and CMSGT Campos, AMC hazardous materials specialists, traveled the globe to get the word out.

The Defense Logistics Agency developed a Performance Oriented Packaging (POP) data base accessible via wide area network for all the services to use. The personal computer program is an easy to use application designed for depot packers of hazardous materials. It provides the packager with the test report information needed for UN packaging and marking. In addition to providing the packaging requirements,

the system provides the Competent Authority Approval (CAA) and the DOT Explosive Registration (EX) numbers for ammunition and explosives.

This is especially valuable because the service schools only address packaging in general terms and do not look at real life packaging problems. The hazardous materials courses emphasize certification requirements and spend little time on Performance Oriented Packaging. DLA training representatives have deployed DOD wide to commands from all branches of service in order to teach this POP computer training. [Refs 10, 23, 30, 31]





## **VIII. DEPARTMENT OF DEFENSE AIR TRANSPORTATION**

### **A. INTRODUCTION**

The transportation of Department of Defense air cargo takes place in a complex and diverse environment. Utilizing military aircraft, freight forwarders, overnight package delivery companies and commercial airlines under contract to the Air Mobility Command, all sizes, quantities, and types of cargo are transported. Amongst this cargo is the full range of hazardous material classes. In fact, the Department of Defense is the world's largest shipper of hazardous materials. Not only does the military ship all types of hazardous materials, but the gross and per package quantities are frequently much greater than other shippers. In times of war and peace, this air freight travels to sites around the world as well as to military bases in the continental United States.

### **B. BACKGROUND**

#### **1. Organizational Structure**

"United States Transportation Command (USTRANSCOM) is the Department of Defense single manager for transportation, other than service-unique or theater-assigned transportation assets." [Ref 32] Exercising operational control over all Transportation Component Commands including Air Mobility Command (AMC), Military Traffic Management Command (MTMC) and the Military Sealift Command (MSC), USTRANSCOM provides policy direction, administrative services, and management oversight for DOD transportation matters. [Ref 32]

At a given military installation, authority for the transportation of materials rests with the "Transportation Officer." Also known as the "Installation Transportation Officer (ITO)," "Traffic Manager (TM)," "Traffic Management Officer (TMO)," or "Defense Transportation System Agent (DTSA)," this person procures transportation services which

meet DOD requirements at the best value. [Ref 32]

## **2. Choosing the Mode of Transportation and Carrier**

When applicable, Transportation Officers need to adhere to "guaranteed traffic agreements" which exist in some geographic areas. A "guaranteed traffic agreement" is a negotiated contract that guarantees nearly all the cargo of a certain type (i.e., general freight) to one commercial carrier or freight forwarder. The agreement does not guarantee a specific volume, only that the winner of the contract will get all the cargo that is available. On October 1, 1994, the Defense Logistic Agency and the Navy entered into an agreement with the freight forwarder, Universal Transportation and Services, to provide transportation services replacing QUICKTRANS.

In the absence of a "guaranteed traffic agreement," Transportation Officers are free to select the mode and carrier of their choice as long as they get the best value for their money. There are exceptions to this routing authority and some are listed below:

- Export cargo shipments
- Top Secret shipments which are routed by the Armed Forces Courier Service (ARFCOS)
- Explosives by rail
- Criteria stipulations on Navy-funded air shipments must be in accordance with NAVSUPINST 4630.22, Use of Air Transportation by Navy Shippers [Ref 32]

From a hazardous material air transportation perspective, exceptions one and four are the most pertinent.

Air transportation best serves cargo meeting the following criteria:

- small cube and/or light weight
- high priority (great need to meet customers' immediate

demands)

- perishable
- high value
- morale enhancing (mail)

With the exception of mail, hazardous material can meet the criteria of all categories.

### **3. Determining Air Eligibility - The Challenge Programs**

It is said that the cost to move a package by air is between ten and twenty times that of surface transportation. [Refs 3, 34] Because of this high cost, the Department of Defense requires that careful consideration be given to the decision to use air transportation. Small air worthy packages (definition of "small" is determined by the various services) are controlled by the Transportation Officer. The Transportation Officer frequently uses United Parcel Service, Federal Express, or the United States Postal Service to satisfy customer requirements. Larger parcels, particularly those destined for overseas locations, must utilize Air Mobility Command (AMC) arranged, operated or negotiated airlift unless there is some documented negative critical mission impact justifying non-usage. If deviation from this requirement is necessary, selection of the air carrier should be made in this order:

- General Services Administration (GSA) arranged or contracted airlift on Civil Reserve Air Fleet (CRAF) carriers.
- Other CRAF carriers.
- DOD-approved U.S. flag carriers.
- DOD-approved foreign flag carriers.
- Non-DOD approved carriers. [Ref 32]

Prior to forwarding a "large" shipment to a military or civilian air terminal for domestic or international transport, the Transportation Officer will submit an Advanced Transportation Control Movement Document (ATCMD) to the appropriate Air Clearance Authority (ACA). Each of the armed services has an Air Clearance Authority which screens the ATCMDs to determine if the added expense of air transportation is warranted. At the ACA the shipment will either be permitted or challenged. If the shipment is challenged, the customer who requisitioned the material must justify the airlift requirement. If the air shipment is permitted, the transportation priority may still be reduced from TP-1 to TP-2, TP-3 or TP-4 (space available air freight) [Ref 32]

The great expense of air transportation, particularly international, has caused the Department of Defense to continuously review and revise air eligibility criteria. Since 1978 the per package weight and volume (cube) thresholds that trigger a peacetime challenge by the Navy's Air Clearance Authority, the Navy Material Transportation Office (NAVMTTO), have declined dramatically. According to the August 2, 1978 Naval Supply Instruction, NAVSUPINST 4630.22B, high priority cargo exceeding 500 pounds would be challenged to see if a surface mode of transportation would provide better cost benefit results. In the mid 1980's the weight cut off was reduced to 300 pounds. Today, nearly all categories of material over 100 pounds are challenged. In addition to the 100 pound trigger, shipment size over 15 cubic feet, shipping costs over \$5,000, and requisitions over 90 days old all are flagged for review. The Air Challenge Program has been successful. In FY93, 13% of all requisitions were challenged, of which roughly 60% were ultimately diverted to surface transportation. Transportation savings from this program for FY93 exceeded \$28 million. [Ref 25, 34]

Efforts in 1994 were less successful. In May 1994 a

directive was issued that only emergency material with a required delivery date within three days would be eligible for air transportation. This unreasonable directive made little impact as it was ignored or circumvented by commands everywhere. [Ref 25]

The high cost of air transportation is oblivious to the end user. Abuses of requisition priority codes create the appearance of greater urgency than may actually exist. A future change that has been endorsed by the services calls for a two tier pricing system for material ordered from DLA facilities. The end user will see two prices, an air transportation price and a surface price at the time the requisition is placed. A decision is made and an obligation incurred by the end user as to which mode of shipment he wishes to pay for. [Ref 30]

### **C. HAZARDOUS MATERIAL**

#### **1. Peacetime Operations**

As stated in prior chapters of this thesis, hazardous material traveling via commercial air carriers is governed by Title 49 Code of Federal Regulations for domestic shipment and by the International Air Transport Association's Dangerous Goods Regulation for international movement. Hazardous material destined for military or civilian aircraft under contract to the Department of Defense are governed by the Air Force Joint Manual 24-204.

##### **a. Commercial Aircraft**

When hazardous material will travel via commercial air, the military shipper is responsible for ensuring that the material is packaged correctly and that the Shipper's Declaration for Dangerous Goods is completed accurately and certified by a competent individual. Whether the material is packaged by the original manufacturer or repackaged by a Department of Defense facility, adherence to Performance

Oriented Packaging is required.

**b. Department of Defense Owned or Controlled Aircraft**

Department of Defense owned or controlled aircraft can use any of the three regulations (49 CFR, the IATA Dangerous Goods Regulation, and the AFM 24-204) to govern their domestic hazardous material shipments. So as not to compete with the commercial sector, air cargo within the continental United States normally does not fly on DOD aircraft unless the continental United States leg is incident to overseas movement. An exception involves oversize cargo or hazardous materials in quantities greater than allowed by 49 CFR. C-141, C-5 and the recently introduced C-17 aircraft are utilized for these exceptions.

For the international transportation of hazardous goods, both the IATA Dangerous Goods Regulation and the AFM 24-204 are acceptable.

**2. Wartime, Contingencies, Exercises and Emergencies**

During times of war, national emergencies, certain military exercises or special contingencies such as humanitarian relief efforts, Chapter 3 of the AFM 24-204 becomes the authorized source for hazardous material transportation guidance. Using DOT exemptions 7573 and 9232, commercial airlines under contract to the Department of Defense are allowed to be use AFM 24-204 as well. During Desert Shield and Desert Storm, 20.3% of the cargo and 62% of the passengers initially deployed to the operating theater utilized civilian aircraft. The use of the CRAF program, phases I and II, supplemented the military's 89 C-5 Galaxies, 195 C-141B Starlifters, and 410 C-130 Hercules transport planes. [Ref 33]

As discussed in Chapters VI and VII, AFM 24-204 greatly relaxes the regulations during tactical operations. Segregation and compatibility requirements are greatly reduced. Limits on fuel and other flammable liquid quantities

are increased to permit collapsible fabric drums capable of holding 500 gallons per container. Vehicle fuel tanks can be three quarters full except those loaded on the aircraft cargo ramp pallet position which can be one half full. Certain items designated as "Cargo Aircraft Only" by dagger and theta symbols in the "Alphabetical Listing of Items Table" are now permitted to fly with the troops. [Ref 24] This action considerably increases the risk to aircraft, crews, passengers and end users. It is the responsibility of the major command (MAJCOM) having operational control over the deploying units to declare chapter 3 operations and to assume this added risk. [Ref 24]

Special Assignment Airlift Missions (SAAMs) can be requested when the amount of cargo and personnel requiring transportation exceeds what can be handled by regularly scheduled flights. Besides quantity, size/configuration or urgency of need can trigger a SAAM request. Operated by the Air Mobility Command, these aircraft are under the control of the requesting major command.

Chapter 3 also allows for the removal of hazardous materials from their normal packaging. Once removed, the material is frequently stored in the racks or containers of tactical equipment or vehicles. An example of this is additional fuel in a jerry can mounted in a storage compartment in the aircraft or on the vehicle.

AFM 24-204 allows armed forces personnel during contingency actions to carry their basic combat load or individual issue of hazardous material as long as the following provisions are met:

- Personnel will engage an enemy force immediately upon deplaning at the objective or will be airdropped.
- All efforts have been made to ensure individual hazardous materials are safe from accidental initiation



(i.e., grenades in fiber containers, safety pin secured, etc.).

- All hazardous materials other than small arms ammunition and nuclear, biological, and chemical (NBC) equipment are prepared for shipment according to this manual, consolidated in one central location on the aircraft as directed by the loadmaster, and distributed to personnel before landing.
- All small arms ammunition must remain in the individual carrier (for example, bandoleers, ammunition belts, pouches), and all weapons must remain clear until the aircraft has landed.
- All NBC equipment must remain in the individual carrier (for example, protective mask bag, mobility bag), and must accompany the individual at all times.
- The troop commander or team chief must brief the loadmaster concerning the individual issue of hazardous materials. A Shipper's Declaration for Dangerous Goods is not required.
- Personnel not immediately engaging the enemy force when deplaning, but assuming a tactical mission on arrival, may deploy with their basic load or individual issue of hazardous materials. However, these items, including small arms ammunition, must be collected by the troop commander before the anti-hijack briefing. On arrival at the aircraft, the troop commander must brief the load master on the hazardous materials and assist the loadmaster, as directed, in the tiedown before departing. The hazardous material will be redistributed on arrival at destination. A Shipper's Declaration for Dangerous Goods is not required.
- Explosives and other hazardous materials must not be handled by personnel during flight operations.

During actual combat conditions, aircraft and theater commanders have even greater latitude in deciding what gets loaded on their aircraft. While hazardous materials are not normally permitted on aeromedical evacuation aircraft, in a combat situation the aircraft commander can allow them. Helicopters inserting or extracting combat troops are exempt from the provisions of chapter 3.

### 3. Air Terminal Operations

Military cargo exported from the United States frequently originates at military air terminals. The Air Mobility Command is responsible for the safe and efficient management of all air terminals worldwide. In areas predominated by the Navy, daily operation of the terminal passes to the Navy. One such location is Norfolk. The Navy AMC Air Terminal at Norfolk is the Navy's largest air terminal handling 35,000 tons of originating air cargo per year. Norfolk Naval Air Terminal describes their mission as follows:

- Receiving and processing cargo and mail from air and surface transportation modes;
- Optimizing airlift capabilities.
- Conducting safe and timely loading/unloading of Navy, Air Force and civilian contract aircraft;
- Providing prompt processing of duty and space available passengers;
- Providing liaison services between shipper services, the air clearance authority, and AMC in order to ensure the orderly flow of cargo. [Ref 35]

As you can see, Department of Defense air terminal operations and cargo handling procedures are strikingly similar to those in the commercial sector.

#### *a. Hazardous Material Handling Procedures*

The position names may be slightly different, but the duties and responsibilities of the hazardous materials handling personnel at both military air terminals and commercial airports are virtually the same.

A typical air terminal divides hazardous material cargo handling functions into four areas or branches. These branches are Customer Service, Receiving, Warehousing, and Ramp. All personnel within the individual cargo branches must be familiar with emergency response procedures and must

maintain continuous interface with the terminal's Air Terminal Operations Center (ATOC).

(1) Air Terminal Operations Center. The Air Terminal Operations Center (ATOC) is the focal point of aerial port operations. ATOC is the terminal coordination center bringing together load planning, manifesting, passenger and cargo loading, and aircraft support services such as refueling and food services. Responsible for on time departures, ATOC monitors all aircraft functions to ensure on time departures. [Ref 35]

(2) Acceptance and Processing. Initial acceptance and processing of "general freight" air cargo is accomplished by the receiving branch. This branch requires basic hazardous material training to aid them in identifying dangerous situations or hazardous materials that have not been indicated as such by the necessary marking and labeling.

The customer service branch is responsible for keeping the cargo flowing. They are responsible for ensuring that all frustrated hazardous and nonhazardous cargo has a proper disposition. This branch responds to telephone and message enquiries regarding cargo expedition, air challenges, tracer requests, and diversions and reroutings. Most all of the 35 personnel qualified in the certification of hazardous materials at Air Terminal Norfolk work in this branch. They check customer hazardous material documentation for accuracy using the applicable publications and, where permitted, correct errors. [Refs 26, 35]

(3) Airport Ground Handling. Personnel working in the air freight warehouse and aircraft parking areas also require basic hazardous materials training. Handlers need to visually inspect packages for damage and leakage, immediately frustrating any found unfit for further transport. Depending on the severity of the leakage and the material contained, emergency response procedures may be

initiated. When material is being stored temporarily while awaiting aircraft loading, attention must be paid to segregation requirements.

A key section within the warehousing branch is the "Special Handlers". Special handling cargo receives expeditious and careful treatment. Examples of "Special Handling" cargo include hazardous, refrigerated, pilferable, dangerous to handle because of size, weight or shape and the highest priority "must ride" cargo. [Ref 26, 35]

(4) Aircraft Loading. Department of Defense owned or controlled aircraft must always be loaded under the supervision of the qualified aircraft loadmaster. Unlike the civilian sector, hazardous material is frequently loaded in the same compartment with passengers, particularly in C-130, C-141 and cargo/passenger configured DC-8 aircraft.

It is important for aircraft loaders to remain in constant contact with ATOC and the ground handling personnel. Good communication is a key factor in safe material transport and in ultimately flying the most urgently required material. Cargo is frequently unitized on aluminum pallets (463L) measuring 88" X 108". On occasion, a loadmaster may rotate or "bump" a pallet of cargo because of a discrepancy or because there is excess "through" cargo from a previous destination. At such times decisions must be made as to which pallet "rides" and which gets "bumped". If time permits, the pallets can be broken down and rebuilt to include only the highest priority cargo with the remainder traveling on a future flight. Without good communication, sound freight movement decisions can not be made.

As the pallets or loose cargo are loaded, the packages should once again be inspected for damage or leakage. Cargo securing procedures are the same as in the civilian sector as are segregation rules except during chapter 3, tactical operations.

#### D. TRAINING

Department of Defense hazardous materials training has been addressed repeatedly throughout this thesis. Suffice it to say that it meets the letter of the law regarding initial and refresher training and is similar in many respects to the commercial sector. There is even an effort to train the customer. For example, weeks before Army troops deploy, the battalion is briefed by air terminal personnel regarding the proper way to package or unitize their belongings. This prevents surprises when the combat gear begins showing up at the air terminal.

## **IX. SIMILARITIES AND DIFFERENCES BETWEEN THE MILITARY AND CIVILIAN SECTORS**

### **A. INTRODUCTION**

The long standing differences between the Department of Defense and the commercial sector's hazardous material handling and transportation procedures no longer exist. Significant changes in recent years, most prominent the introduction of the new Joint Manual 24-204, have substantially aligned the two operations. The AFR 71-4, once the "bible" of terminal operations, is today obsolete. The DD form 1387-2, previously the primary focus of all military air hazardous material training, has been replaced by an industry standard commercial form accepted worldwide.

Clearly the action of the United Nation's International Civil Aviation Organization dramatically changed the world's hazardous material air transportation practices. In the United States, the 1990 passage of the Hazardous Materials Transportation Uniform Safety Act (HMUSA) was the catalyst for the myriad of changes we see today and the introduction of the AFJMAN 24-204.

### **B. SIMILARITIES**

Military and commercial hazardous materials air transportation procedures are now more similar than they are different. The Department of Defense has implemented the use of CD-ROM technology for distribution of manuals and now uses a Wide Area Network (WAN) computer system to disseminate Performance Oriented Packaging information. Regulations pertaining to packaging, documentation, forms preparation and quantity restrictions have been standardized. Training goals and requirements have been aligned.

Hazardous materials handling job descriptions, duties and responsibilities and installation procedures are virtually the

same as in the commercial sector, as are the steps taken in emergency response situations.

### **C. DIFFERENCES**

A fundamental difference between the two sectors revolves around the idea of risk. The Department of Defense is willing to take greater risk every day and substantially greater risk in times of national emergency. You might say that this additional risk is the price of freedom in the volatile world in which we live.

#### **1. Wartime Environment**

The primary difference between the Department of Defense air transportation operations and those of the commercial sector is the environment in which they take place. The military air cargo system is designed to function in harms way. Aircraft must be able to land on ships at sea, on make-shift runways crafted from jungle and desert terrains, and while under attack from enemy fire.

#### **2. Volume and Diversity of Material**

The second significant difference is the quantity and type of hazardous material transported. As discussed previously, the Department of Defense is the world's largest transporter of dangerous goods in both quantity and breadth of items. This is particularly true in the area of explosives. At the 1992 Hazardous Material Packaging and Transportation conference held at Wright-Patterson Air Force Base, the Air Mobility Command's Del Hamilton provided the following examples of common DOD hazardous material shipments which routinely exceed the indicated amounts permitted in the civilian sector:

- Diesel Fuel: 1.25 gallons (passenger aircraft) or 13 gallons (cargo aircraft only) per container.
- Flares (C/D 1.4G): Forbidden in passenger aircraft and no more than 165 pounds net weight on cargo aircraft.

- Flammable liquids N.O.S.: Depending on flashpoint, quantities could be limited to 1 quart (passenger aircraft) or 7.5 gallons (cargo aircraft only) per container.

As discussed in Chapter VIII of this thesis, during contingency operations, 500 gallon, collapsible, fabric drums of flammable liquids are authorized for transport. Mr. Hamilton also pointed out items commonly used in support of military operations which are forbidden from transport aboard civilian aircraft. Examples of these items are explosives in class/divisions 1.1, 1.2, and 1.3 and certain types of poisons. [Ref 24]

### **3. Passengers Transported with Hazardous Material**

Commercial airlines, following the IATA Dangerous Goods Regulations or Title 49 Code of Federal Regulations, do not allow the commingling of passengers and hazardous material in the same compartment space. The Department of Defense routinely ships hazardous material in the same compartments as passengers on their cargo aircraft in both peacetime and contingency operations. Additionally, Department of Defense procedures allow passengers to travel with forbidden or restricted hazardous materials.

### **4. Compatibility Requirements are not as Strict as Commercial Standards**

As discussed previously, compatibility refers to the ability to commingle different classes of hazardous material without harmful effect. For example, oxidizers which support combustion by releasing oxygen should not be stored or loaded in proximity with flammable substances. During normal operations and particularly during contingency or tactical operations, compatibility requirements are significantly less stringent aboard military aircraft.



## 5. Training

While the requirements and goals of Department of Defense hazardous materials training are equivalent to the civilian sector, imagination, coordination and the benefits of current technology are lacking.

Although it is true that the revisions to the old AFR 71-4 were reviewed with packaging personnel from the various services at two recent seminars, the service schools are currently unprepared to teach the provisions of AFJMAN 24-204. This seems remarkable considering the long leadtime involved in the manual preparation. No service has taken the initiative to revise the curriculum. To compensate for this void, the Air Mobility Command has chosen to independently conduct training at its aerial ports worldwide in an effort to protect lives and assets.

Training methodology has traditionally emphasized form preparation and publication familiarization at the expense of the "big picture" and other hazardous material transportation areas. The use of videos, CD-ROM technology, and computer based training has not historically been employed.

## **X. CONCLUSIONS AND RECOMMENDATIONS**

### **A. CONCLUSIONS**

The objective of this research was to compare and contrast civilian and military hazardous materials air transportation procedures. As Chapter IX indicates with the adoption and impending implementation of Air Force Joint Manual 24-204, procedural similarities now greatly outnumber differences. The smooth integration of the two sectors is a significant accomplishment and one which had previously never been attempted.

The success of Air Force Joint Manual 24-204 is not by accident. When the 1990 Hazardous Materials Uniform Transportation Safety Act made Air Force Regulation 71-4 obsolete, the armed services, led by the Air Force Material Command, chose a progressive course of action for the replacement publication. Relying heavily on a global paradigm, and espousing the philosophy of interoperability, they smoothly integrated the United Nations International Civil Aviation Organization recommendations into United States military policy and procedures.

The drafters of AFJM 24-204 realized that as the financially driven downsizing continues, the Department of Defense must rely more heavily on "off the shelf" technology and emphasize interoperability. There must be the smoothest possible interface between the service components, international militaries, active and reserve forces, and the civilian sector. Redundancy and military unique procedures have become less affordable. AFJM 24-204 provides the solution to seamless integration with the commercial sector while still allowing for the special procedures required in times of national emergency.

## **B. SUBSIDIARY RESEARCH QUESTIONS**

- 1. In what ways can the Department of Defense benefit by modifying its procedures to more closely match those of the commercial sector?**

With the adoption of the Air Force Joint Manual 24-204, the Department of Defense has taken a giant step towards aligning its hazardous material transportation procedures with those of the commercial sector. Where differences still exist, they are necessitated by the unique nature of the military's mission. A major benefit to the Department of Defense is achieved through the adoption of the Shipper's Declaration for Dangerous Goods in lieu of the DD Form 1387-2. The Shipper's Declaration enables uninterrupted world-wide integration between the military and the commercial airlines. This seamless interface between the two sectors is enhanced further by the AFJM 24-204's inclusion of the United Nations recommendations and the provisions of the 1990 Hazardous Material Uniform Safety Act.

- 2. Are there drawbacks to more closely aligning procedures with the civilian sector?**

As long as the tactical and contingency provisions of Chapter 3 remain a viable option for military leaders when warranted by circumstances, there are no drawbacks to the closer alignment.

- 3. In what ways can Department of Defense hazardous material training programs be improved?**

The same level of joint cooperation that produced the superbly written, easily understandable manual AFJM 24-204 is required to design a corresponding training program. The fact that a comparable training program can not be brought on line simultaneous with AFJM 24-204 implementation is disappointing. So much has changed in the hazardous materials arena that the new training program should be designed from the ground up. Parochialism must be put aside. All aspects of hazardous materials must be taught, not just publication referencing and

form preparation.

Modern training aids such as computer based training, interactive CD-ROM technology, videos and the use of actual packaging materials will provide a richer, more complete and effective student learning experience.

### C. RECOMMENDATIONS

The service components should design and implement a joint services training program that effectively conveys the vast changes in hazardous materials transportation procedures enacted by recent legislation.

The Air Force Joint Manual 24-204 should be taught in an interactive manner so that the student not only leaves the classroom with book knowledge but also with a working knowledge of hazardous materials packaging and transportation.

The Air Force Joint Manual 24-204 is a rich publication, well researched and written. It is imperative that the soldiers, sailors, airmen and marines understand the provisions of this manual. The safety of Department of Defense personnel and equipment is at stake.



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